SECOND ANNUAL REPORT

OF THE

CHIEF EXECUTIVE VITICULTURAL OFFICER

TO THE

BOARD OF STATE VITICULTURAL COMMISSIONERS,

FOR THE YEAR 1882-3.

OFFICE: 111 Leidesdorff Street, San Francisco, Cal.

APPENDIX III. Different Methods of Grafting the Vine.

SACRAMENTO:
STATE OFFICE.....JAMES J. AYERS, SUPT. STATE PRINTI
1883.

PREFACE.

One of the most important studies for our vine-growers is now and will continue to be that of grafting. The necessity of knowing all that we may learn in this branch of viticulture, besides making new experiments, must be obvious to all who reflect upon two features of our industrial development, viz.:

First—The advantages to be obtained by grafting vines of inferior quality with scions of nobler varieties.

Second—The reconstitution of vineyards attacked by phylloxera, by planting resistant vines, which must be grafted with our noblest varieties.

In a few years there will be thousands of acres grafted annually; but the greatest difficulty is the want of special knowledge and experience. Many vine-growers imagine that grafting is a risky business. Permit me to assure them, not theoretically, but after practical observation and experience, that nothing is more simple and safe in our industry. It needs, however, theoretical knowledge and strict rules to insure success. Each proprietor should master the principles and become able to instruct his workmen. I intend in my regular report (these appendices are in advance of the report they are to accompany) to discuss this subject from practical experience, and to suggest some improvements on the methods discussed in the translations herewith presented to the public. Our industrious Secretary, Mr. John H. Wheeler, has translated the important parts of a work recently published in France, by Aimé Champin, author of the Champin graft, which are considered by us as typical studies for those who desire to experiment with grafting. We shall, however, confine ourselves to a few methods, when we are ready to give our recommendations. I have some experiments now being proved, of which I shall write fully in my report, viz.: such as grafts made successfully in the month of August on vines of different species, etc.

Grafting the vine is practically a new study, and we may, with this work well digested, go forward on even terms with our friends in France. In this we have not, as in fermentation, etc., the arrears of generations to overcome.

To illustrate the possibilities of this new feature in viticulture, I will only at this time say that I expect to show by my experiments made this year that the best time to graft young vines is in the month of August and in the latter part of October, certain exceptions being made as to the August grafts where very severe and early Fall frosts are to be feared. I have had occasion to show a peculiar value in Fall grafting lately, when recommending to a gentleman who has recently imported some Huascar cuttings from Chili, to preserve them most efficaciously by grafting at once on old vines; it being known, of course, that cuttings of vines from the southern hemisphere arrive here during our period of vegetation.

The caution I wish to insist upon is that, while reading of so many different and curious methods of grafting, the student should not become enthusiastic over any fascinating invention unless the same has been practically demonstrated in the field. There are few methods, however, that may not have at some time an easy application of great importance, and all should be understood thoroughly.

CHAS. A. WETMORE,
Chief Executive Viticultural Officer.

SAN FRANCISCO, October 21, 1883.

VINE GRAFTING,

BY AIMÉ CHAMPIN,

Propriétaire Viticulteur, Membre du Conseil général de la Drôme, Président du Comité d'études et de Vigila de Montélimar, Membre de la Société des Agriculteurs de France, etc.

(EXTRACTS TRANSLATED.)

JOHN H. WHEELER, SECRETARY OF THE BOARD OF STATE VITICULTURAL COMMISSIONERS, TRANSLATOR.

I.—GRAFTING BY APPROACH.

Grafting by approach may be either above or below ground, each of which will be considered separately.

A.—GRAFTING ABOVE GROUND BY APPROACH.

There are many methods of forming the union between the graft and subject above ground; many, too, are simple and lead to an easy success; they require, however, one precaution not necessary with grafting of other fruits, viz.: that of having the point of union below the surface of the soil. The graft by approach is the only system which will succeed in the open air above the soil. It is not known why the vine, like other plants, cannot be grafted above ground, but it is thought, in explanation, that the proper wax or sealing material for the operation has not been found, and it is suggested that we may at some time be able to employ the many other systems of grafting besides that by approach when the proper wax be found to bind the parts together. With the graft by approach no difficulty is encountered.

This method is divided, according to the subject and graft or scion used, as follows:

1.—OLD EUROPEAN VINE AND SCION OF A YOUNG RESISTANT VARIETY.

The end to be obtained here is the substitution of a resistant vine for a non-resistant vine—the converting it into one which may be attacked but not destroyed—and thus utilize the infested vine so far as practicable. To do this, plant the subject or vine to be grafted near each of the infested vines at a distance varying from ten to twenty inches or more, according to the distance apart of the old vines. The subject so planted may be a rooted vine, seedling, or even a cutting.

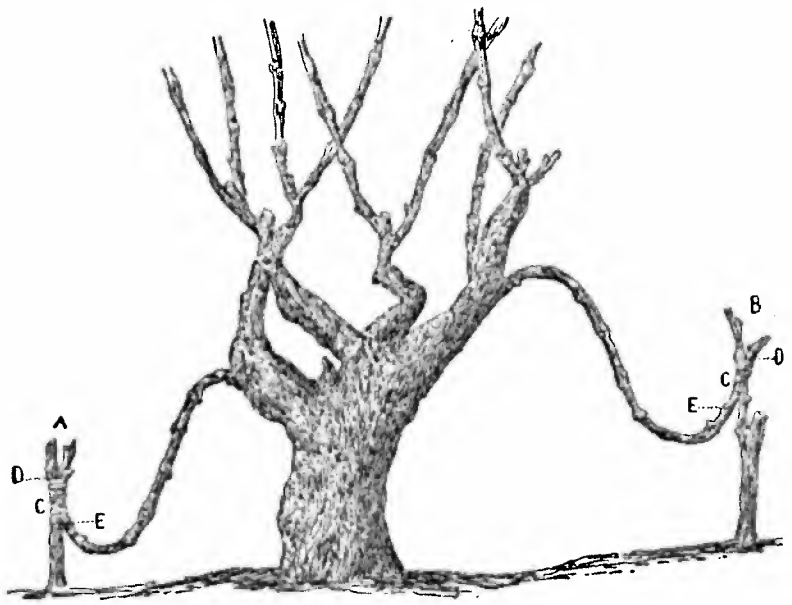


FIG. 1.

At the time of planting (Figure 1, *A*), or the year after (Figure 1, *B*), a branch from the infested vine is bent over to the resistant stock in such a manner as to render the two in parallel contact throughout two or three inches, at which point of contact the grafting is performed (Figure 1, *C*, *C*).

To do this, it is sufficient to lay bare the wood of the two adjoining surfaces for from one to two inches in length, and then bind them close, in such a manner as to bring about a complete adherence of the two bare surfaces; after this, wax must be applied to exclude the air entirely from the interstices, or cracks, formed between the two parts where the contact may not be perfect.

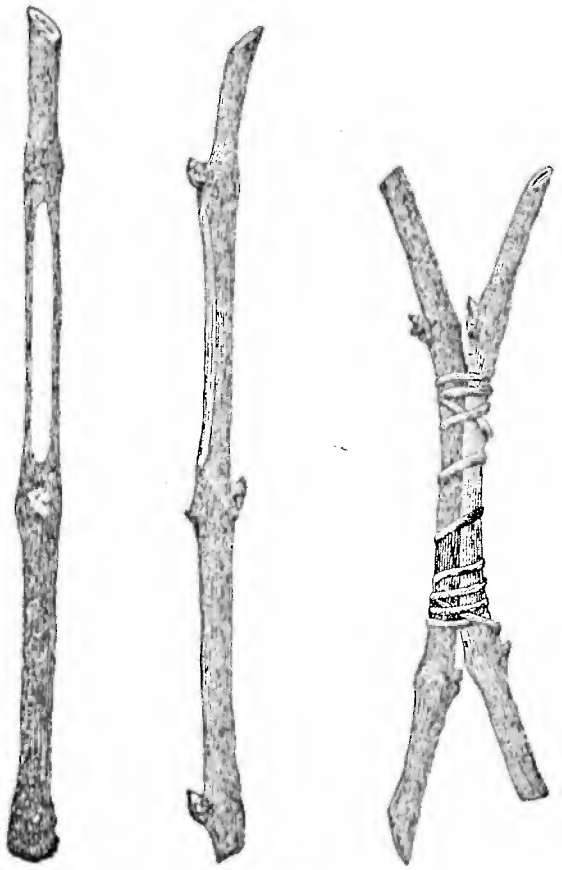


FIG. 2. FIG. 3. FIG. 4.

The Figures 2, 3, and 4 make plain the practice of putting the parts in shape.

The union will not be slow in forming, and the graft is certain to take if the operation is well performed and the two surfaces be in proper contact. Each plant now sends forth shoots from the buds above the graft or point of union, perhaps one, perhaps more. At this time the desired stock is encouraged by pinching off and retarding the growth of sprouts growing from the resistant vine. The graft must now be carefully examined to see that the tie, or cord, may not strangle the new growth; if growing too tight, it should be removed and replaced properly. As to the suppression of the undesirable stock, this may be done when the union becomes so fixed as to resist the twisting or shock of the wind.

When assured that the sap is circulating in the proper channel and the joint is becoming fixed, the operator may proceed to cut off the upper part of the resistant vine, smooth and entire, at the point *D*, Figure 1. When the union is complete, and not until then, can the connection with the infested or non-resistant vine be severed at *E*, Figure 1, underneath the union. If not severed now, the vine will

develop beyond the union in a manner disproportionate with the small root, and, further, draw off to itself a portion of the returning sap, which should go to develop the new branches.

2.—GRAFTING ABOVE GROUND BY APPROACH OF HERBACEOUS SHOOTS BETWEEN AN OLD EUROPEAN VINE AND A YOUNG RESISTANT VARIETY.

When the grafting method, just described, becomes impracticable or fails to answer—perhaps owing to a press of time at the grafting season, which is in Spring; perhaps the graft made has not united or been successful; still further it may be the herbaceous or green graft is preferable—the following method may then be adopted: bring the green and growing branch of the European vine and that of the resistant vine together, and unite them in the same manner as already shown in Figure 1, *B*, Figures 2, 3, 4.

The operation here is a delicate one, requiring a skillful hand and a gentle force in tying. Wax here becomes useless, as the sap at this season is sufficiently abundant to close all joints or openings and form a union without fear of contact with air. The same precautions are observed in making this graft as in the one described before, with additional care as to the tie which might otherwise strangle the vine, break the twig or graft when joined. The earlier this graft can be made the better, as by so doing the union has more time to connect and solidify.

The month of June is the most favorable month for this system of grafting; in midsummer a good union is obtained, and throughout the hottest period, even to the end of July or later. It is not prudent to put it off till late, especially in the north, in which regions it becomes impracticable in all but during a short time. It is essential that the branches be large and strong in order that the graft may connect and solidify before Winter.

These methods of grafting above ground offer three advantages, viz.: an almost absolute certainty of the grafts "taking;" the avoidance of all chance of the plant becoming free from the grafting stock; and finally the possibility of preserving the vineyard with its uninterrupted profits up to the last, even till all infected or susceptible vines shall have disappeared,—a process which enables the new and grafted plantation to supply the deficit of the old in just the proportion in which the latter declines.

But aside from these advantages there arise sundry inconveniences. Though the graft by approach be easy in itself; though it be easy to prepare and place together the two pieces of cane which require intimate contact, yet it is not always easy, as one would suppose, to find canes of the proper size; it requires time, repeated trials, and then we often fail to find the right one. Finally it becomes necessary, as the diseased vines die, to grub them out and to uproot and remove as much as possible the diseased parts; this deranges and injures the roots of the young and resistant vines.

A still more serious injury arises from the evil infection of the soil already supporting diseased vines and the previous exhaustion of the same soil by the old plant. The soil might be reinforced with fertilizers, it is true, but this would not avoid the injury done the young plant by disease contracted from the old and rotten roots of its predecessor. All of the parasites developed on the old roots proceed to the new vine, and, although the American vine is ultimately

resistant, still the attacks of injurious parasites should, as much as possible, be kept off from the young plant while in its first growth and while starting, and it should have all aid and nourishment possible.

Thus we find corresponding evils to set off the advantage of the system, and it is only where the infected vines are young and newly diseased that the advantages arising by this method more than compensate for the evils incurred in the use of it.

In view of the difficulty of uniting a detached scion to the vine, some vignerons, in order to make use of the approach system, have conceived the idea of planting two vines, resistant and desired stock, together, and uniting them above ground by either the herbaceous or lignified canes.

As there exist a number of methods of uniting the two vines above mentioned which may be of use, they will be given to avoid useless repetition further on when desiring to refer to them.

3.—HERBACEOUS GRAFTING ABOVE GROUND BY APPROACH—NON-RESISTANT ON RESISTANT CUTTINGS.

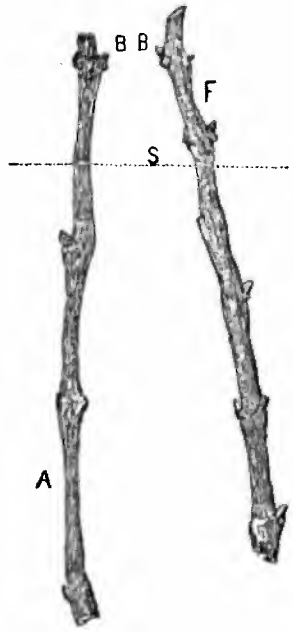


Fig. 5.

The cuttings, one resistant and one European, should be planted together, occupying the position of a single vine as planted by the ordinary methods. Care is needed in putting the bud that is to develop the grafting cane opposite that to be grafted—both on the near sides of the cuttings, as represented in Figure 5.

When the two canes develop enough to permit of operating upon them, they are bound together after having pared off the bark and some of the green wood of each. Care must then be taken to keep the union firm and not strangle it; to pinch back the shoot from the resistant one and encourage the other, and finally to completely sever the European vine beneath the point of grafting from its own root.

4.—HERBACEOUS GRAFT BY APPROACH ABOVE GROUND BETWEEN TWO ROOTED VINES, RESISTANT AND NON-RESISTANT.

As the resistant vines, notably the American varieties, are more vigorous and grow more rapidly than the European or other non-resistant varieties, a disproportion may arise between the two plants, which will make it impossible or impracticable to unite them; this, with the chance of both cuttings not growing, argues strongly in favor of planting rooted vines instead of cuttings, which thus assures the success of the graft. The operation is illustrated in Figure 6, in which graft No. 3, given before, is used.

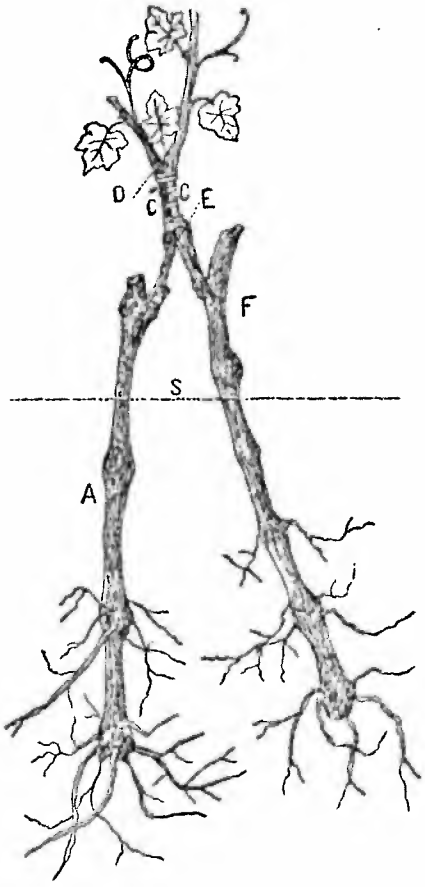


FIG. 6.

5.—HERBACEOUS GRAFTING ABOVE GROUND BY APPROACH—ROOTED NON-RESISTANT ON RESISTANT CUTTINGS.

This is often resorted to, to overcome the difference in growth which arises between the rooted vines of the resistant and non-resistant varieties, and for this purpose succeeds admirably. The European variety may be planted in the usual manner to insure its proper development before another season; then, in the following season, the American cutting is inserted at its side in such a manner that the shoot proceeding from it, which grows so luxuriantly, may form a subject on to which the vine already one year old may be grafted, in place. Even a rooted resistant variety may be planted instead of a cutting, its growth being sufficiently retarded by the transplanting to produce uniformity.

6.—WOODY GRAFT ABOVE GROUND BY APPROACH BETWEEN YOUNG VINES, RESISTANT AND NON-RESISTANT, IN PLACE.

Where unable, for any reason, to unite the vines, resistant and non-resistant, the first year, the union of the lignified wood may be made by grafting the canes from the two in place, the operation being performed in the following Spring in the same manner as with herbaceous shoots illustrated in Figure 6.

7.—WOODY GRAFTING ABOVE GROUND BY APPROACH OF ROOTED VINES BEFORE PLANTING.

The greatest obstacle to the herbaceous graft is that it must be done in a certain place and time—the beginning of Summer, as to time. In the following we are enabled to avoid these difficulties:

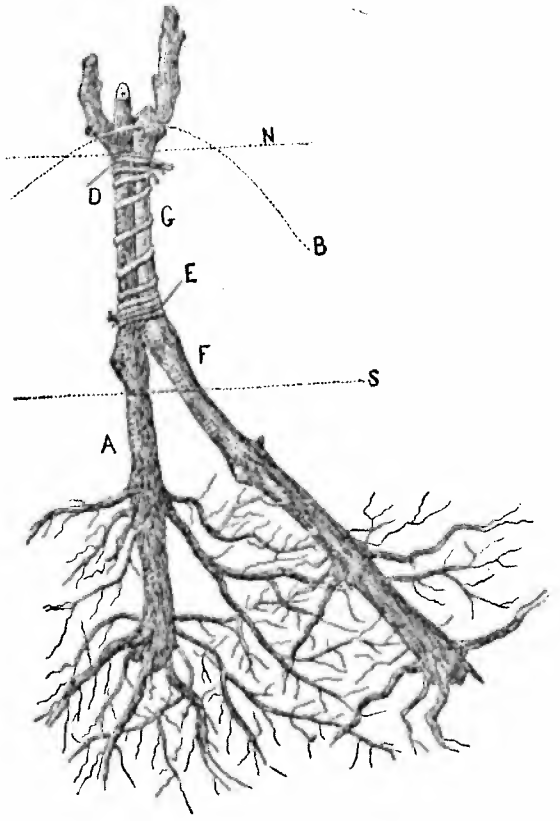


FIG. 7.

The two plants to be united are taken to a suitable and convenient place, convenient for the operator. Then, in grafting, the most favorable point for the union to be effected can be chosen at will, may be two surfaces of the old and original stalks, as in Figure 7; may be an old stalk of one and a new growth on the other; or it

may be the new growth of the two, as seen in Figure 8. The vines are cut and prepared, adjusted, tied, and waxed, and in planting care should be taken in maintaining the point of union, *G*, a little above the soil, Figures 7, 8, 9, 10, *S*, representing the surface of the soil. Further, the resistant vine should be set in the desired place, *A* (Figures 7, 8, 9, 10); that it be maintained straight and erect, curving the non-resistant vine, *F* (Figures 7, 8, 9, 10), if necessary, in order that the roots may be so arranged as to be easily removed when severed from the other plant.

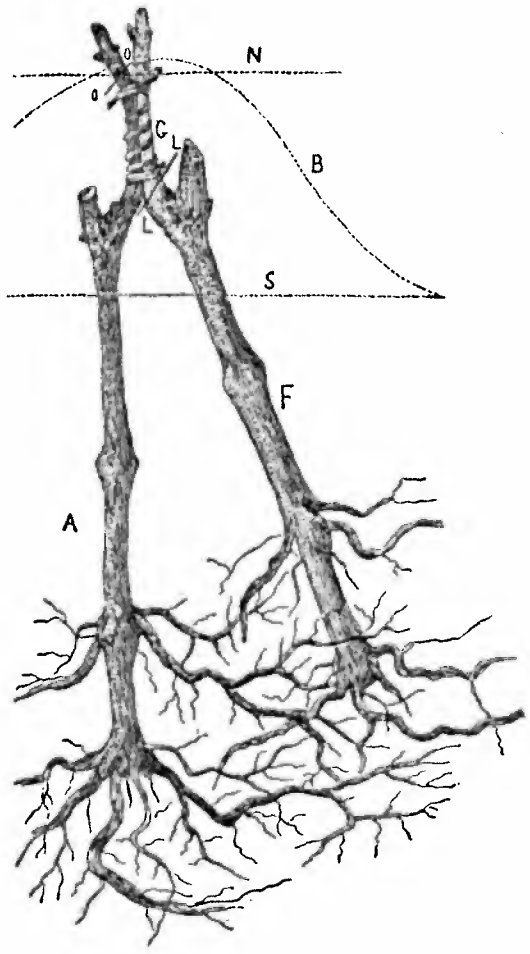


Fig. 8.

8.—WOODY GRAFTING ABOVE GROUND BY APPROACH OF CUTTINGS ON CUTTINGS, PREVIOUS TO PLANTING.

Fig. 9.

Cuttings have the advantage of being more supple, and accordingly presenting a greater number of sides or surfaces to choose from; further, by the use of cuttings a year's time may be gained in the planting over putting them in nursery. It may happen here that one of the cuttings—the two of which in this case form both subject and graft—takes root and the other does not. So much the better if it happens to be the right one, as this would do away with the necessity of removing the roots of the non-resistant vine, this being the one which does not root. If, on the other hand, it be reversed, and the wrong cutting takes root, which, however, is rarely the case, then the planting of the resistant variety will have to be repeated.

9.—WOODY GRAFT ABOVE GROUND, BY APPROACH BETWEEN A ROOTED RESISTANT VINE AND A NON-RESISTANT CUTTING, BEFORE PLANTING.

This system, borrowed in part from the preceding, has for its first advantage that of employing a non-resistant cutting, which is easily and quickly procured, instead of being bothered with a rooted vine (Fig. 10). It possesses the advantage over the graft of cutting to cutting,—which surpasses it in simplicity,—of furnishing sap to the graft more abundantly than could a simple cutting.

10.—WOODY GRAFTING ABOVE GROUND BY APPROACH BETWEEN A NON-RESISTANT CUTTING AND A RESISTANT VINE ROOTED AND IN PLACE.

This system is given for utilizing whatever resistant vines which may be retained in place; and for the purpose of grafting those resistant vines on which the graft, set perhaps in the same year, owing to one cause or another, did not take. Grafting can usually be kept up later than is generally supposed—when done by approach any time will do—from midsummer to the end of Summer, thus enabling one to operate again on those which did not succeed in Spring. This graft differs from the preceding only in that the vine grafted is in place, and the earth must be moved at its roots to permit of planting the graft by its side, the hole to be then carefully filled.

After the union is effected all are treated alike, the only difficulty being, that common to the other grafts, of removing all of the roots

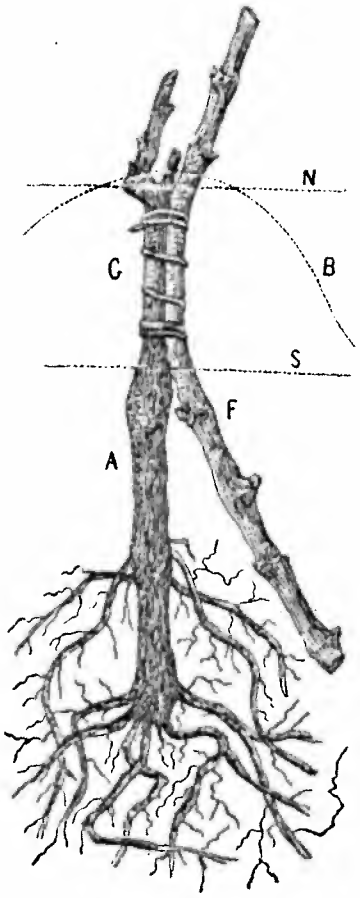


FIG. 10.

of the non-resistant vine. When the graft and plant have become firmly united, the sooner the roots can be separated the better, for even at the soonest, considerable damage results to the resistant vine in separating the roots. When the grafting can be done in the nursery, especially if done by inexperienced hands, the vineyard may be planted with growing resistant vines and the roots disturbed but once.

11.—GRAFT BY APPROACH WITH INCISION AND LANGUETTE, OR ENGLISH LATERAL GRAFT.

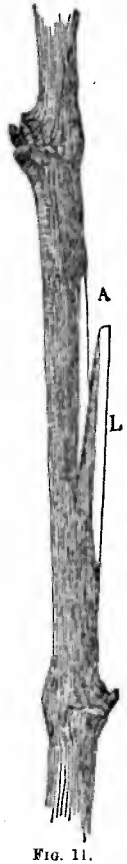


FIG. 11.

This consists of a simple modification of the ordinary graft by approach in its simplest form. The principle may be applied to all of the systems heretofore explained and to a large number of those to follow.

In place of simply laying on the two surfaces alone, an incision is made in each, as seen in the cut, one third down from the bud, *A* (Fig. 11), in one, and two thirds down from the bud, and the incision upwards on the other, *A* (Fig. 12). The depth of the incision should be about equal to one third of the surface laid bare. When prepared, as above, the tongue of one is inserted in the incision formed in the other in such a manner as to cover all wood laid bare by that of the corresponding part on the other cutting; then bind and wax up as in other grafts. (Fig. 13.)

This system claims the advantage of presenting a more extended surface to bring in contact, and thus facilitate the circulation of sap between them, and also to fix the joint more firmly and rapidly. As regards its value and practicability, it may be said that this system, applied to the free graft, is valuable, but in joining the parts as above, laterally, the union is always incomplete and the graft very difficult to make.

Before leaving the "above ground" work, which is not very common on the whole, it may be of interest to know of a very ingenious plan practiced by a certain viticulturist of l'Ardiche.

This vigneron raised both resistant and non-resistant vines in numerous pots, which same could be placed in the nursery, hot-house, or elsewhere, not interfering with other culture; then, when required, the same vines were readily transplanted from the pots and united.

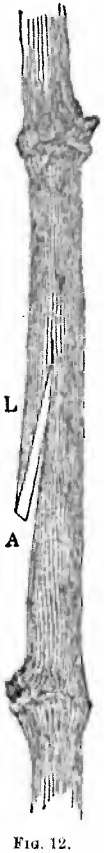


FIG. 12.

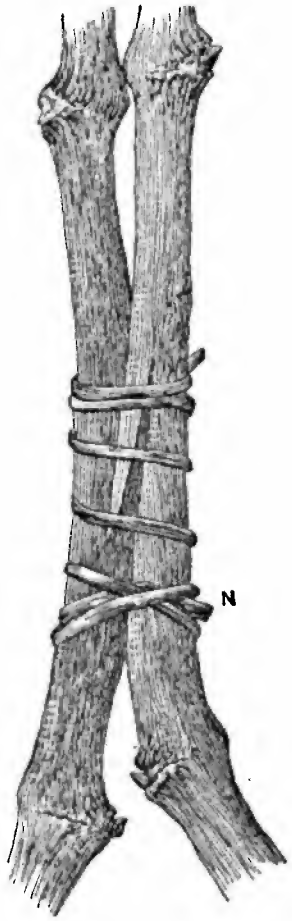


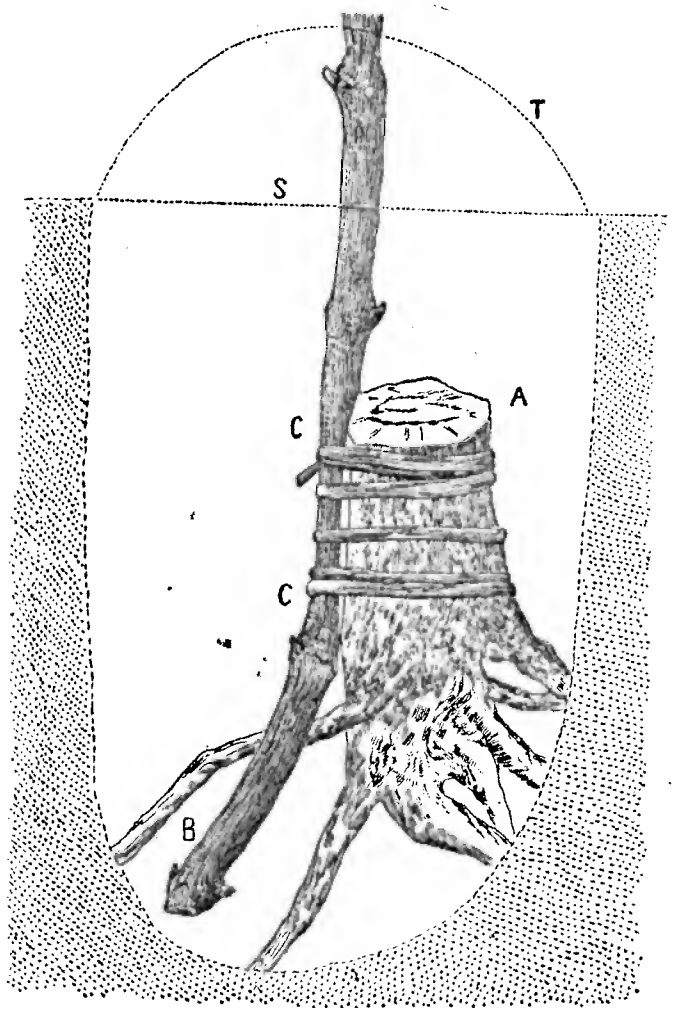
FIG. 13.

B.—GRAFTING BELOW GROUND BY APPROACH.

Although so numerous, some vignerons have practiced all of the methods of grafting contained in this publication, and also, to make the list complete, the following systems, which must therefore be included. Some, as may be seen, are sufficiently explained by the cuts or figures presented and require no further description.

12.—GRAFTING BELOW GROUND BY APPROACH OF A RESISTANT CUTTING ON AN OLD NON-RESISTANT VINE.

This method is employed to utilize the remaining vigor of an old non-resistant vine, by transferring its remaining vitality to the young resistant vine at its side; the method has been and continues to be frequently used.



A smooth woody surface is prepared on the side of the old vine, which has been cut off deep down, and a corresponding surface formed on the cutting, as seen in Figure 14; the point of union coming well below the surface of the ground, *A* (Figure 14), the contact should extend through several inches, *C C*, and the cutting extend deep enough to retain one or two buds below the point of union. If, however, the point of union be far enough below the surface to permit of roots forming successfully at or about the joint, then this latter precaution may be overlooked. After carefully adjusting the two prepared surfaces, the whole is bound and the joint cemented with a little clay, after which the loose earth is heaped up over the graft, as indicated by *T* (Fig. 14). (1)

As a means of rapid multiplication this proceeding is a good one, if desirous of using the resistant plants so formed elsewhere, or even there, when the old vine is not diseased; but if diseased, and one desires to establish a new resistant vine in the place of a non-resistant diseased vine, its objections are immediately apparent. As a still further objection, it may be said that under the influence of the old vine root the young graft is developed in a marked disproportion to the development of its resistant root system; then when the phylloxera completely destroys the old roots the new vine roots are not sufficient to keep up the new branch system, not yet having penetrated to a sufficient depth.

In this graft the cutting becomes an accessory plant. As indicated in the title, this operation is applicable to the fixing of a resistant on a non-resistant vine. It is further applicable to the fixing of a resistant on a resistant root, but never to the fixing of a non-resistant on a resistant, for the taking root of the graft is only the adverse of what is desired.

13.—GRAFTING BELOW GROUND BY APPROACH, BETWEEN A ROOTED RESISTANT VINE AND A ROOTED NON-RESISTANT VINE. (Figs. 7 and 8.)

14.—GRAFTING BELOW GROUND BY APPROACH, BETWEEN A CUTTING AND A NON-RESISTANT ROOTED VINE. (Fig. 10.)

15.—GRAFTING BELOW GROUND BY APPROACH, BETWEEN CUTTING AND CUTTING. (Fig. 9.)

These three systems of grafting, the work of which may be done before planting, differ from the same above ground only in one particular, viz.: that the point of union, *G* (Figs. 7, 8, 9, 10), is placed below ground (dotted line *N*) when planting, instead of above (dotted line *S*); a difference, however, which is sufficient to deprive them of the greatest advantage of the above-ground graft, inasmuch as the former is apt to root both plants independently, and to free the non-resistant vine to its own resources and subsequent weaknesses.

By the adoption of a simple device, the advantages of this system may be utilized to good effect by placing the point of union at or below the surface of the soil and then covering up the vine for a few inches (dotted line *B*) by piling up the earth against the same. This protects the graft and may be removed at pleasure.

(1) The representations surrounding Figure 14 apply as well to Figures 16, 21, 22, 31, 34, 35, 36, and even in certain cases, to Figures 23, 24, 32, 33, 64, when they represent grafts made beneath the surface.

Fig. 15.

16.—LALIMAN'S GRAFT BETWEEN CUTTINGS WOUND ABOUT EACH OTHER.

Mr. Laliman, of France, an indefatigable promoter of viticulture, and especially of the American vine, claims to be the inventor of this graft, which is at once simple, ingenious, and sure to "take." It has been adopted on a large scale by some prominent viticulturists, and appears to produce excellent results.

The resistant and non-resistant cuttings are wound about each other, thus obtaining a continuous contact of the two, or at least, in enough places to assure the union being formed. (Fig. 15.) The double cutting is then planted, which puts forth alternately canes of resistant and of non-resistant stock; also the same of alternating roots. The canes desired are easily distinguished, and those not desired pruned out. With the roots, however, the phylloxera alone can determine them, and to the insect this must be left.

Some viticulturists have adopted, practiced, and recommended this system, and it is certainly an ingenious contrivance for assuring the union of the two plants. They are united certainly at two points, and finally grow together throughout, forming, ultimately, a vine half resistant and half non-resistant. The question arises, is this sufficient to withstand the attacks of the phylloxera? This must be answered by experience, and by experience alone. It may be well believed that in this, as in others, where a part of the root system is susceptible, it will fail just when the vine is developing itself with the dependence on all of its roots, and thereby bring about an improper and evil disproportion between roots and top so hurtful to the plant.

II.—CLEFT GRAFTING (En Fente).

The ordinary cleft grafting and notch grafting, with their various modifications, have long and commonly been resorted to when desirable to change the stock or production of a vine, or for any other purpose; its use grew out of the necessity of replacing poor stocks, etc., and is common to all vignerons.

17.—SIMPLE LATERAL CLEFT GRAFTING.

The vine is first laid bare down to the lateral roots, and then cut off horizontally two inches or more above them. With a grafting knife sufficiently strong to bear hammering with a mallet, a slit or cleft is cut in one of the sides, pointing to the center and deep down on the outer side. (Fig. 16.)

Fig. 16.

A graft, or scion, is then selected, long enough to permit of at least one eye being above ground. This is then cut converging for a length of from one to two inches or more at its lower end, so as to fit the notch cut in the growing vine. (Fig. 17.)

To make this fit, the scion should be beveled to allow of the woody surfaces coming together completely, as seen in Figure 18, too much

Fig. 17.

being better than not enough, for it is on the exterior surface that the union must be complete.

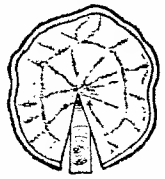
The transverse sections shown in Figures 19 and 20 exhibit the two methods of doing this—one wrong, *A*, and the other right, *B*. Anything like *A* should be carefully avoided.

Fig. 18.

To place the scion properly in the slit, it may be opened with the knife, pressing the same over to one side and withdrawing it when the point of the scion has been inserted; some use a wedge-shaped piece of wood, which serves to open the crack, and the scion is quickly inserted, when the wedge is withdrawn. (*C*, Fig. 21.)

The graft is here so well protected by the stump that it usually needs no tying to keep it in place, especially when the slit does not traverse the whole stump, as in this case the pressure of the wood on both sides is sufficient to keep it in place. It is always necessary, however, to wax the joint well, to stop up all cracks, and to cover over all surfaces left exposed by the knife or saw, after which the earth should be carefully heaped up over the joint thus made.

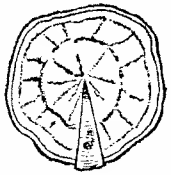
Fig. 19.



A

18.—SIMPLE TRANSVERSAL CLEFT GRAFTING.

If the root be wide enough to permit, it is often desirable to put two scions into one stump, which is done by cutting or splitting into the stump transversally, so that the opening is continuous across the



B

Fig. 20.

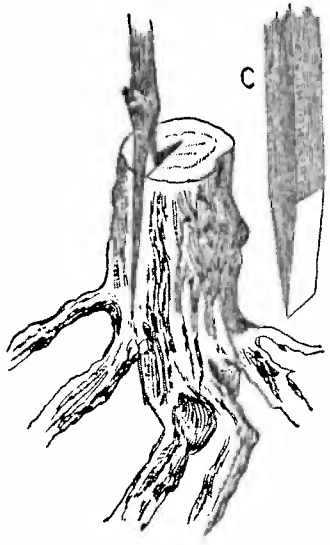


Fig. 21.

whole. At the two extremities of the slit so formed the scions are

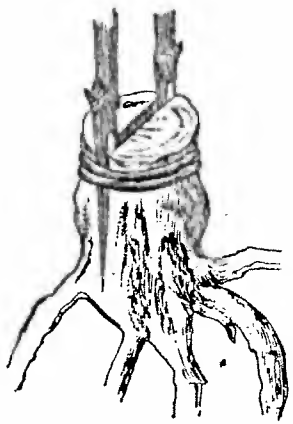


Fig. 22.

The scions should be made of uniform size in order that the slit may be spread to an equal width at both sides, and thus fit the sides of the scions and bring the bark of both into contact. With a little judgment it may be easily determined whether the joint needs tying, or whether the point of the scion is squeezed tight enough to hold it in place and resist a slight tap or knock.

This transversal graft is most frequently employed when the subject root is equal to in size or but little larger than the graft, as by this a uniform fit and contact of the two parts is assured, and thereby a ready growing together of the bark and perfecting of the union. If the root be large enough for two scions and still small, the two scions may be put even contiguous, as represented in Figure 24.

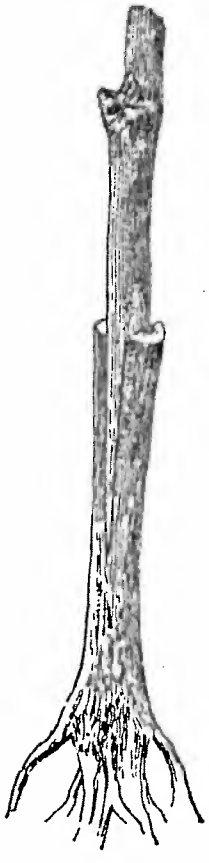


Fig. 23.

Fig. 24.

Fig. 25

In all cases where the graft is to be fixed on the vine in place where the vine is cut off to receive the graft below the surface, and it is desired that the graft itself should take root and eventually succeed the old stock with independent roots; it is then preferable to make the slit or cleft in the graft itself and point the root so as to receive the graft astride of the root. But when the grafting is done after the vine or root has been planted and the above transformation in the roots is not desired, the simple cleft graft is best employed even with cuttings.

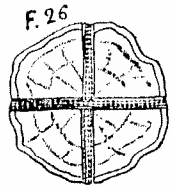
It is advantageous in all cases, in order to assist the cut in healing over, to bevel off the edges of the piece which has been split, as represented in *B*, *B*, Figure 25.

19.—SIMPLE CROSS CLEFT GRAFT.

Cut two slits perpendicular to each other and insert four scions instead of two. (Fig. 26.) The same operations with regard to tying and waxing apply here as well as to the preceding systems.

20.—SIMPLE OBLIQUE CLEFT GRAFT.

Fig. 26.



The operator may sometimes be unable, for some reason, to split the vine crossways; perhaps the vine would be injured thereby; perhaps the pith or middle would not permit of it, being unsound. Again, it may be desirable to have six grafts instead of four. In any of these cases the vine may be cut bias on three sides, as represented in Figure 27, the cuts forming chords of the circle; into each extremity of these chords a scion is inserted, whose point is cut obliquely, as represented in Figure 28. This system usually requires tying before applying the wax.

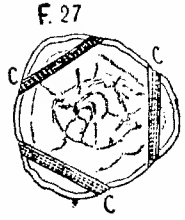


Fig. 27.

21.—CLEFT GRAFTING, WITH A CUTTING GRAFT.

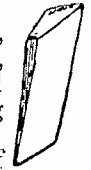


Fig. 28.

In place of cutting the scion and inserting, we here make a cleft on one side of the vine, after cutting it off at the proper depth, and into the slit thus made insert the cutting prepared, as in Figures 29 and 30.

The sides of the cutting are pared off obliquely to a point, allowing two or three buds above, and

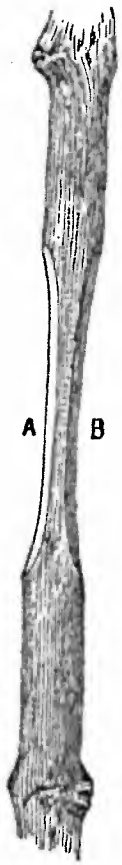


FIG. 29.

enough wood below to reach well down into the ground by the side of the vine. (Fig. 31.)

The cutting, placed as in Figure 31, is well waxed and the earth raised over it to protect the joint. It is useless to explain how these grafts may be bled by making a transversal cleft, quadrupled by three cuts on a bias, etc.

22.—INVERTED OR SADDLE-CLEFT GRAFT (A CHEVAL).

This system is best illustrated by inverting the ordinary simple cleft graft. (Fig. 32.)

When grafting rooted nodes or shoots, or small rooted vines, or even roots, it becomes especially valuable to be able to point the latter and cleave the graft itself. The process is an easy one: with the ordinary grafting knife with hooked blade the cut is made upward on each side, thus pointing the root in good shape,—whether it be knotty or disabled it matters not.

When the cleft is made downward or on the root, there is danger of gravel falling into it, or dirt even may injure it. Again, the crack thus made forms a receptacle for water, which, in case of insecure waxing, may run in. This latter danger is the greatest one, and one which the utmost care should be taken to guard against. In the inverted cleft graft, all danger from both the above sources is avoided, the upper piece forming a covering of the whole.


FIG. 30.

No grafting is easier than this, nor is any more apt to be done right than this, on account of its perfect simplicity, the surfaces adapting themselves so readily and the parts being so easily handled. Cases are cited in which this system has been used in grafting on simple rooted joints or nodes, done within doors and away from the field, on Taylor, Cunningham, Norton's, Cynthiana, Herbemont, etc., and on rooted vines of Jacquez, Black July, and Louisiana, all of which sent forth roots and branches like a year old vineyard from rooted vines. These cases include only grafts made on roots or rooted vines, but it is believed that by using varieties which take readily, it might be used to connect cuttings with easily rooting varieties.

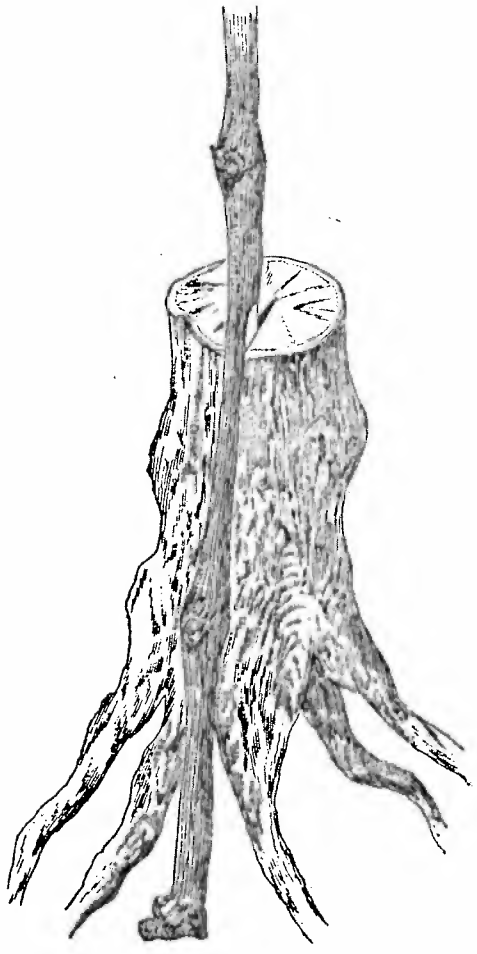


FIG. 31.

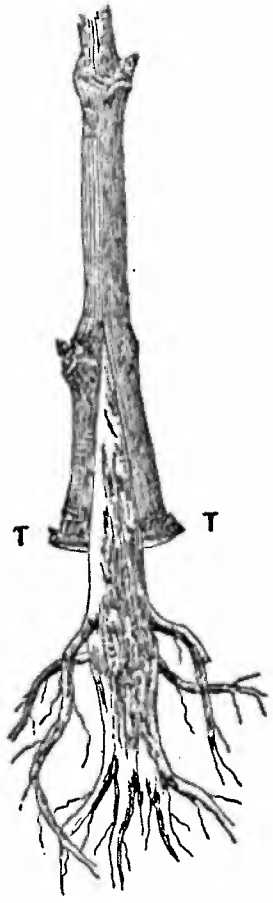


Fig. 32.

Fig. 33.

The graft is so simple as to hardly require illustrations. It may be seen by Figure 33 how the same graft may be duplicated if the root be wide enough. In concluding this system, it need only be said that this graft, being especially designed to facilitate the rooting of the graft, should be so cut as to prepare for the proper putting forth of roots, as, for instance, *T T*, Figure 33.

III.—NOTCH GRAFTING.

In cleft grafting the wood is split only, this answering the purpose. The plan has been conceived by some of notching the wood and then cutting the graft round, square, or wedge-shaped, to fit exactly the notch so formed. Numerous terms have been applied to this system, and also numerous instruments have been invented for making the notch to receive the graft, as well as for fashioning the graft to be inserted.

The terms and methods applying to the various modifications of the system are:

23.—SQUARE LATERAL NOTCH GRAFTING.

24.—POINTED OR WEDGE-SHAPED LATERAL NOTCH GRAFTING.

25.—ROUND LATERAL NOTCH GRAFTING.

Figures 34, 35, and 36 indicate plainly the three.

FIG. 34.

FIG. 35.

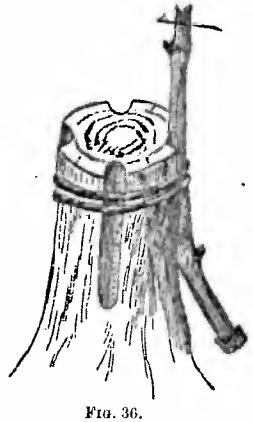


FIG. 36.

From these figures it is readily understood how this system, as that by approach and that by cleft, may be applied, any one of the three, for

26.—NOTCH GRAFTING WITH CUTTINGS.

Of which an example is seen in Figure 36.

IV.—LAYER GRAFTING.

Throughout the age of vine-growing, the soil adjacent to the mother plant has been used, and sometimes improperly, for renewing vines; the same being done by simply burying the branches, in order, in forming a new plant or setting, that nutrition should continue from the mother vine while making its roots. This system becomes especially advantageous in the introduction of cuttings difficult to start, and in assuring the successful multiplication of any other vines, and for these purposes it is utilized in a number of ways.

27.—LAYER GRAFTING OF RESISTANT ON NON-RESISTANT VINES.

One of the first uses made of layer grafting was that of uniting the resistant, *A* (Fig. 37) on the non-resistant, *F*, vines, an operation which with other systems is quite difficult.

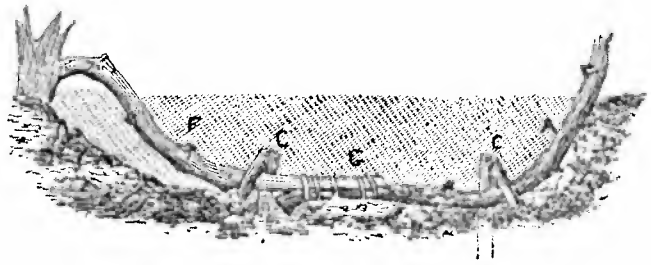


FIG. 37.

After making the graft, the union, buried from four to six inches beneath the surface, is maintained at this point by two wooden crotches or notched stakes, *C C*. The system employed in joining the two pieces is of secondary importance, and one may use the simple or double cleft, the inverted graft, or graft by approach, as in Figure 37, *G;* only, care must be taken to have the variety which it is desired to root on the downward side.

Suckers may often be found which will answer for this graft and thereby avoid the necessity of using the fruit wood. The sucker serves to root equally well, and draws little sustenance from the vine. By the use of this system of propagation, fine rooted plants, giving canes many feet long the first year, have been obtained from the Jacquez, Cynthiana, Norton's, Virginia, and Black July, supplied, as above, by vines almost dead and past bearing entirely.

If old vines be employed to root resistant vines by this method, the old vines may be best prepared for the operation by cutting off the previous year near the surface of the ground, thereby causing them to put forth a generous supply of suckers.

28.—LAYER GRAFTING OF A NON-RESISTANT ON A RESISTANT VINE.

In the preceding method it was desired to obtain a rooted plant of resistant stock on to which, subsequently, a non-resistant variety might be fastened. With this the latter necessity is sought to be avoided by forming a resistant root, and then joining some desirable variety on to this at a point so near the surface as to be able to prevent the graft from taking root and thereby becoming non-resistant. In this case care must be taken in fixing the length and position of the long cane, in the selection of the graft or scion, and especially in selecting the system for uniting the parts.

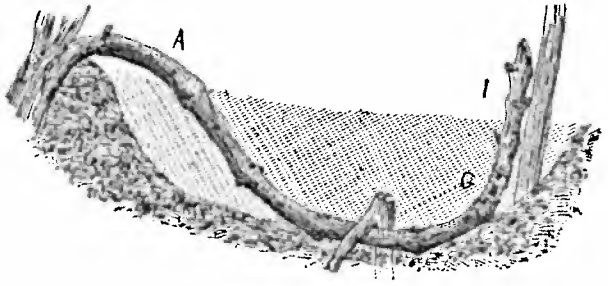


FIG. 38.

The non-resistant scion *I* (Fig. 38), must be placed near the surface of the soil to avoid its taking root; to accomplish which the cane to which it is to be attached must be long enough to allow of the bend being made entirely in the resistant branch, *A*. When the rooted plant thus formed shall be transplanted, the following year the point of union *G* should be placed at the surface of the soil. The layering and covering of the graft requires the greatest care possible. As to systems employed in uniting the parts, the simple cleft graft (No. 18, Fig. 25), or, better still, the Champin graft, described further on, is especially suited.

29.—LAYER GRAFTING, BY INSERTING A RESISTANT BETWEEN TWO NON-RESISTANT STOCKS.

This system is applicable when the vigneron is in possession of non-resistant vines and resistant cuttings, and it is desired to obtain a proper producing variety on a resistant stock the first year, making a sure union and forming abundant roots and a strong plant. To do this we combine the two preceding systems, giving the curve to the cane of the non-resistant vine, *F* (Fig. 39), uniting with whatever

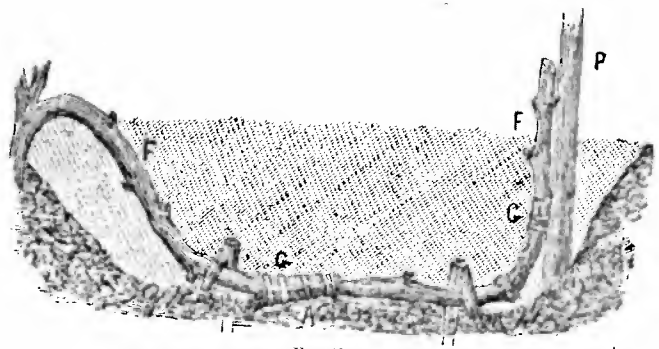


FIG. 39.

system may be most desirable at *G*, and leaving at least two or three buds on the resistant cane; then give all care possible to the second graft, *G*, and success is certain.

All operations connected with this system are of the greatest simplicity and easily performed: a suitable cane is selected in its natural position; grafted in this position at a height convenient to work, the second being done likewise at a convenient height above the ground. The trench being dug, the vine thus augmented and changed is laid down and fastened with care, and the whole covered over after tying the graft up to a stake. There is equal simplicity in Figures 37 and 38. Care is necessary in layering and covering the cane, to avoid deranging the grafts.

V.—GRAFTING ON ROOTS.

Grafting on roots is quite as old a custom as grafting on branches, but does not play a very important part in viticulture, at least not for uniting European vines on resistant stocks.

30.—GRAFTING A NON-RESISTANT STOCK ON A RESISTANT ROOT.

Fig. 40.

The first requisite is a root of the proper size to permit of the insertion of the scion. This is by no means easily found. Laying aside the case in which the operation is performed on the root of a vine remaining in place, or a single one or few, it is no easy task to satisfy the important requisite of this graft.

Of the young resistant vines taken up from the nursery to be planted elsewhere, there are some few to be found large enough and suitable, *R* (Fig. 40), to receive the non-resistant graft.

This graft offers no difficulties in execution, taking perfectly; but so rarely is it used that its advantages need not be dwelt upon here. The same system will be found under another form in the "graft on rooted nodes or joints."

31.—GRAFTING A RESISTANT CUTTING ON ANY VINE ROOT.

This is often done to make sure of the growth of a cutting, and is of great practical utility, as it enables any kind or size of roots to be used; to be sure, the roots of resistant stocks would be the best, for after assisting and supporting the plant in the formation of its root system, it would in itself prove an important aid by increasing the resistance of the whole radical system; but the resistant roots, lacking others, could be substituted with equal temporary benefit. Nor need the size of the root matter; it may be tacked on, *A B* (Fig. 41), by approach or cleft, if small, or if large enough the inverted system *C C* may be used. It is easy to choose between systems of uniting the parts, depending, of course, on their size, shape, etc. When this system is practiced it becomes next to impossible to determine where the joint has been made, especially when the inverted graft has been used.

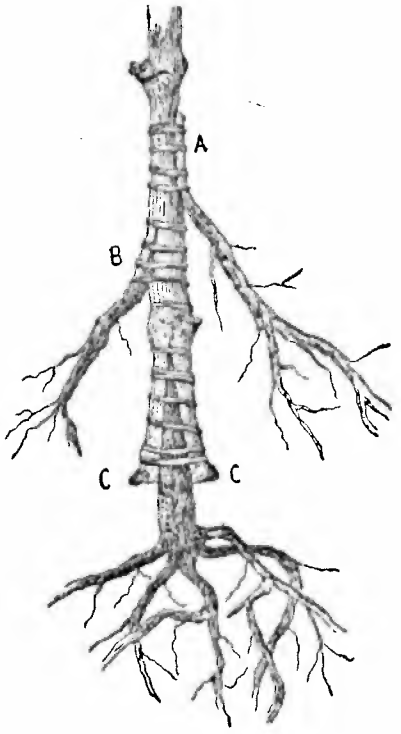


Fig. 41.

VI.—MIXED GRAFTING.

All of the systems given in the following chapter are easy of execution and take readily. Several of them are applicable to the common methods of culture and are generally serviceable; some, on the other hand, are useful only in certain cases; none are there which are not more or less practicable and useful.

32.—ARCH OR REVERSE GRAFT.

This resembles graft by approach No. 1, except that in place of giving the graft a double curve in the form of an S, and thereby producing a parallelism in the two parts, a curve of the graft is brought from above into union with the subject, to which it is to be attached, into which latter it is inserted in a manner somewhat similar to that adopted in the cleft graft. (Fig. 42.)

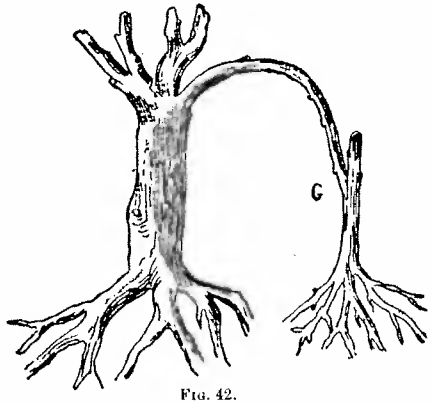


Fig. 42.

The system used for uniting the parts may be that by lateral incision, as seen in the figure, or by simple or double cleft. This graft is used at the present day in some places, and recommended even by official documents, from which Figure 42 is copied. It depends on the principle that the sap circulates indifferently in either direction. The subject, in which the sap circulates differently from that in the graft, becomes readily united to it and continues to nourish it, when, after the union is formed, the graft is separated from the mother vine.

33.—CROWN GRAFT.

Instead of splitting the vine to receive the graft, the latter is inserted between the bark and the wood, first being trimmed down to a long slender point, pared off on a single side only, which is made to slide smoothly along the wood beneath the bark. This system is

one of the best, and is especially useful for aerial woody grafting of trees with regular and flexible bark. But it is difficult and uncertain when applied to the vine, because of the irregular, twisted, and cracked bark.

34.—HALF-CUT GRAFT.

Fig. 43.

Figure 43 explains this graft, in which the two surfaces of contact, parallel *A*, *B*, are carefully adjusted to secure the circulation of sap. Here the right angles, *C*, *A*, *B*, and *D*, *B*, *A*, and the end surfaces, *C*, *A*, and *B*, *D*, present, besides the difficulty of properly adjusting them, a condition very unfavorable to the proper uniting of the adjacent and end to end parts.

35.—SHIELD GRAFTING.

Shield grafting is too well known in its application to horticulture to need explanation here. It has not given me good results applied to the vine, and for good reasons it is hardly adaptable to viticulture.

36.—SHUTTLE GRAFTS.

Fig. 44.

This is an ingenious operation, which consists of inserting with the bud upwards (*H*, *B*, Fig. 44)—an eye, cut off in the form of a shuttle; designed, in the first case, to furnish branches of the variety desired for fruit; in the second case, to furnish a stock desired for roots, which roots, in the latter case, are formed more readily than if the subject above be depended upon. Both are usually necessary to form a resistant vine and furnish desirable fruit.

37.—BORING GRAFT.

In place of grubbing up the old vine, or of making use of it by attachment with other grafts, using wax, etc., we are here content with sawing off the vine horizontally beneath the surface of the ground; then, with a gimlet, screw, or auger, boring a hole near the circumference, may be vertical, or, better still, inclined from the outer edge toward the center of the vine, and being a trifle larger than the scion to be employed. The hole thus bored should be from one to two inches in depth. The graft is deprived of a portion of its bark, and sometimes a portion of the wood is whittled away. It is then forced, or perhaps driven with a few taps of a small mallet, into the hole prepared. It is here seen to be unnecessary to use either grafting wax or cord, the earth with which it is to be covered serving in its place. It is necessarily solid, perfectly adjusted, and at first blush appears to possess all the conditions favorable to the perfect union of the parts; not so, however, for although appearing to unite, because of the moisture furnished by the old vine, it is really not united, and will seldom develop properly. The failure may be owing to the derangement of the fiber, resulting from the forcing in of the scion, or it may be owing to the difficulty in obtaining a perfect fit without injuring the parts. Be that as it may, this system I should advise leaving to experimenters, or to those who "always succeed."

38.—THE INLAID GRAFT.

Fig. 45.

It would be unreasonable to suppose that from the start, in devising the various systems of grafting, some one should not think of performing the work with a machine or instrument, and that with sufficient precision to make the parts cut to fit each other mathematically. (Fig. 45.) Machines have been invented, and with them we may cut out the piece, and the new part then by hand, bind and wax, and all is done. It has been truthfully said by those who have used the machine, that every other eye in the vine thus prepared will put forth except the one which has been added. Various choices may be used in making the cleft and corresponding joint to fit.

There yet remain grafts on double branches, grafts by incision, tongue and cleft, lateral, simple or double, and a whole series of grafts, based on diverse theories of their inventors or on funny fictions. Each day reveals new methods of grafting, which, though novel, some interesting, others valuable, for the most part afford only laughing stock for the viticulturist.

INDOOR WORK AND DOUBLE-CLEFT GRAFTING; OR, CHAMPIN GRAFT.

A. Champin, the French author of this work, is accredited with first having proposed and made common the methods of grafting within doors for the vineyard. He does not claim the credit of inventing the indoor work, but only its first application to vineyard work.

I.—THE WORK WITHIN DOORS.

There are certain marked objections to grafting as performed in the field. To lay bare the trunk of the vine to the proper depth, and that over an area sufficiently large to permit of its being sawed off horizontally, the notching or cleaving of the vine without allowing the dirt to enter, and the introducing into the cleft grafts, to fit which it may be necessary to change their shape a number of times, to attach them solidly and to wax them—all these are operations which require close attention, skill, and precision, coupled with hard work for the feet, knees, back, and hands; then, too, the elements, rain, mud, etc., have to be contended with, rendering this important operation one of some chance in execution. Days must be chosen, which are rare in the season, proper for the operation.

It is desired in what follows to give to the reader a few methods which overcome the objections above given, and to substitute a system easy of execution, moderately certain in its results, and one in which time, and especially weather, may be left out of consideration.

Practical men are apt to deride the indoor grafting system as a viticultural fantasy, but it is stated by Mr. Champin that in consideration of its great economy in labor, time, and opportunity, together with the marked success obtained through its use, it is of the utmost practical importance. It often becomes necessary in hot and dry climates to suspend operations during the middle of the day. In moist climates weeks are sometimes lost in awaiting a favorable epoch. All this is avoided with the indoor system. Grafting in the field is an exceedingly difficult operation and very fatiguing, and although answering where small plantations are made, it is not applicable to vineyards containing thirty or fifty thousand vines, unless skilled labor be cheap and laborers plenty. With the indoor system any day or hour may be chosen, and the grafts, innumerable, may be made by the fireside or anywhere within closed premises. It is often objected that the subject for grafting by this method must necessarily be too diminutive to properly nourish the graft; that the vines should have attained an age of four, five, or six years before grafting.

All of the above are insufficient to overcome the one advantage secured by indoor grafting, viz.: the length of time through which the grafting period may be extended and the greater amount of work thereby accomplished. By calculating the time required in reconsti-

tuting with grafts a few thousand acres of vines by other systems, it will be seen that, all things considered, we should never catch up with the march of the phylloxera. For instance, allowing a skilled vineyardist to graft in the vineyard one hundred per day, a fair average, this means ten days per acre (one thousand vines per acre), and it may be seen that the most valuable time of the vineyardist; or that at a season when time is very precious, would be entirely consumed. By resorting to work which can be done under cover it is found that through all periods alike the work may go on and available time is doubled, and by the use of proper contrivances, machines, etc., the number of grafts may be trebled; then, too, those may labor within doors in ease and comfort who might be incapable of doing so in the vineyard, or at least only with tiring and trying exertion.

II.—PREPARATION OF THE VINE TO BE GRAFTED.

We are now to consider the system which demands our attention only where and when it becomes convenient; for instance, at a convenient time we arrange for our work in the garret, barn, or other convenient place which provides sufficient room, a table, on which are fastened grafting machines, and about which are placed the vines to be operated upon and the scions.

The operation may be applied to one of two kinds of subjects—may be a rooted plant or may be a cutting.

To arrange for the former the work must be provided for at least a year in advance, by rooting the cuttings in nursery, or by forming rooted nodes—burying the cane while growing and attached to the old vine in the vineyard.

1. Rooted vines are plants formed from cuttings placed in the earth the previous year, and which, during the Spring or Summer, have emitted roots, which roots must be carefully protected until returned to the soil.

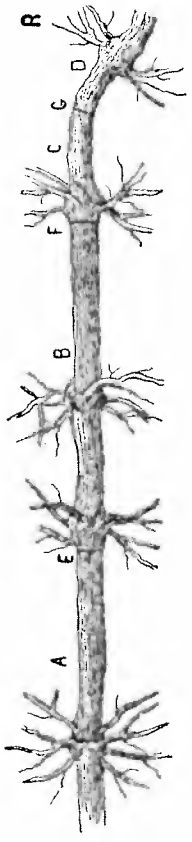


FIG. 46.

2. Rooted nodes are produced accidentally or purposely in the old vineyard; in fact, the grafting within doors I first practiced on this class of roots. From the Cynthiana, Norton's, Virginia, Herbemont, and Cunningham, layered in Spring, I was able to dig in Fall nodes of considerable length and proportions, some of which possess roots but no branches. After using those, with branches for other purposes, the remaining rooted nodes it struck me I could utilize by grafting on to them cuttings of susceptible varieties, or varieties difficult to root by grafting *à cheval*, or with the saddle graft, which was the only process applicable to such small pieces.

From the French grafts on these rooted nodes, from American stock, I have obtained excellent results, the rooted nodes having been formed by carefully layering the canes, and allowing only their extremity to project from the ground.

The American vines are usually long between the joints or nodes, and thus admirably suited for this purpose. A single layer or cane provides an excellent subject for grafting, and, if desired, it can be cut up into a number of subjects, each to receive a graft.

Thus, for instance, the root represented in Figure 46 gives, by cutting at *E* and at *F*, two good subjects, *A* and *B;* then by cutting again at *G* we have two smaller ones, *C* and *D*—both good for the saddle graft, or *à cheval;* it making but little difference to the graft or the subject which side the sap comes up.

It has before been remarked that after the canes of the vine have laid in the earth a year—and more so, for canes lying covered for two years, which have put out roots—their tissues suffer cer-

tain important changes which transform the cutting to a root; they become dense and fine; the pith diminishes and the sap increases; all of these serving to favor the taking or connecting and the consequent success of the graft. The rooted nodes of the Cunningham, among others, partake of the appearance of ivory in their white lozengy tissue, with moist and brilliant reflection; this indicates an abundance of sap. Layering I recommend to all grafters as an easy and economical means of procuring roots for grafting; useful among all varieties, and especially among those the cuttings of which are difficult to root.

3. Simple cuttings are the third kind of subjects employed, and which, on the whole, perform the greatest service. It is well that cuttings used for this purpose should have at least two or three buds beneath the point of grafting, though one may be made to answer in extreme cases.

Now, all of our plants to be used in grafting, being prepared some time in advance of the work itself, should be kept in moist sand, neither dry nor wet, in some cool place, with northern exposure, covered and protected as much as possible, and, if convenient, under lock and key. This makes a perfect treatment.

Up to the year 1879 inclusive, I have kept my plants and scions without other covering than sand, they being placed, perhaps, in a tub on the north side of a wall, or perhaps in a deep trench. But the incessant rains, which have continued from October till June, have caused me and many others so much annoyance and damage, that I now insist on the necessity of the grafter having some cover; for instance, a cellar ventilated and not too wet. Again, a cart house or other shed may be used, open or exposed to the north, in which the roots, cuttings, scions, and all may be preserved until needed for grafting.

I insist on the above method of preservation of stocks and scions, which is not, however, so necessary in the south, where the season is milder. Some months there are when covering is unnecessary, but, following the records, it is found that there may be six months of wet and wind.

III.—PREPARATION OF THE GRAFT.

In the first place, let me protest against the very common practice of cutting the scions, like the cuttings, six months before they are needed. In spite of the fact that they may be kept this long, it is still true that the shorter time they are kept the better.

The best time to prepare the scion is in February and March, as late as possible before the sap begins to move; not that the new sap would become an obstacle or detriment in itself, but because the subject or root should be somewhat in advance in starting of the scion, in order that the union may grow upward from below. If the scion were in advance of the root it would be more apt to dry out perhaps before the operation, or possibly after it. Once cut from the vine, the canes destined to furnish scions should be put under cover, protected alike from all atmospheric influences—heat, which robs them of some of the sap, wind, which dries them, and excessive moisture, which will serve to rot them.

The effect of moisture on scions or cuttings is singularly variable, a fact which I am unable to explain, but which I know to be so. For instance, branches may be entirely submerged in clear water, or even a pure mud, and allowed to remain there a whole month without losing their properties to unite and grow. Again, a much less time's submersion in a wet medium—in sand or earth—may so fill them with moisture as to totally obliterate the sap and render them incapable of making a union, or even growing as cuttings.

The condition of the pith is, above all, important in determining its value. In its normal state the pith varies from a brown or almond color to a clear, brilliant, or micaceous yellow; it is fresh in appearance, and is always a little glittering—never the color of silk, pasty, dull, blackish, nor fuliginous, these latter being signs of deterioration. When a branch presents these latter symptoms, my grafter cuts off and rejects joint after joint until arriving at a healthy pith. This process I recommend to all grafters, for it is better not to graft at all than to employ poor scions.

We have not finished the examination when knowing that the cane or scion has not been injured by moisture; we must further know that it is not too dry. It is often difficult to determine when the cane is too dry to be used for grafting, fit then only for firewood.

The pith of the vine will indicate to us readily enough whether the cane has been damaged by moisture or not, but it will not determine its damage by drying. For the latter, the appearance of the wood is of the most value. When the wood is of a beautiful green, all is well. When it is whitish, although green in color, or when dry, though somewhat green, it is necessary to suspect it. The color is the best optical guide, but even this is not certain enough. The one infallible sign is freshness itself; it must be so to the touch and by general appearance; it must show a surface glistening with moisture, especially where cut diagonally and held so as to reflect the light; the sap must be fresh, and the surface cut, luminous.

It is a difficult task to determine when the graft should be rejected, and the only way to eliminate failure in judgment of it is to reject all that we are not certain are fresh. It does not pay to run any risks in choosing the good ones. It sometimes occurs that the grafts of a

somewhat doubtful nature are so valuable or scarce that a trial with them may be the only expedient; in this case they should be allowed to stand a few days in water, a process, however, which is perfectly useless for fresh scions. When soaked, it should be in tepid water, not cold, and the graft then submerged only partly, the water covering the lower part of the cane, and the upper part exposed. This operation is not to introduce the water into its pores, but the moisture, with the warmth and air, revives its vitality, puts its sap in motion, and renews the dormant life yet remaining in its tissues. We may be able by this process to put the cane in such a condition that it may be used with confidence.

Finally, if it be some precious and unique cutting, which, in spite of our endeavors, shows neither life nor glistening sap, and we risk it, it then becomes a miracle if revived from its inertness to a vitalized organism.

IV.—CHOICE OF THE GRAFT AND CONDITION OF THE BUDS.

All of the branches of a vine do not possess the same qualities, nor are the same qualities to be found in any two successive buds, from the butt to the extremity of the cane.

When grafting a tree, the operator always selects the scions with great care, discarding them in accordance with their inherent defects, the condition of their buds, and the buds which will put forth. We expect the bud of a red rose to produce a red rose, a white grape to produce a white grape, a large pear to produce a large pear, similar to that of the mother plant. For these qualities this will answer, but there are others to be sought for, to find which requires study and observation.

Fructification, more or less rapid, more or less abundant, more or less constant, is one of the qualities which is regularly transmitted. Experience regularly proves that the production on certain trees may be biennial by grafting, as with the pear, for instance. Grafts taken from the pear during its year of repose will never be so fertile as those taken from the same tree covered with fruit buds. Again, if from the same pear tree grafts be taken from one branch, a fruiting branch, and from another, a non-fruiting branch, the trees formed from the first will possess a natural tendency to fruit; from the latter, to produce wood. The part produced by the latter may be influenced to fructify; but as this influence will act stronger in the former, there will always continue a difference, resulting from the difference in the scions.

The vine being naturally very prolific, we are but little concerned at present with this question, which, however, would become very difficult if studied and applied in accordance with the true theory to large vineyards; but I have deemed it necessary only to draw attention to this question, which does, in its use, ameliorate the objection to some choice varieties, which are shy bearers, by the judicious choice of grafts.

Even the buds of the same cane present differences, like the canes themselves. Those buds nearest the spur or butt give vigorous vines and produce long and heavy canes without producing abundance of grapes. Those at the extremities of the branches differ in producing more fruit than wood. As to those in the middle, they have medium qualities. My own opinion leads me to prefer the middle buds, because I recognize in them the following excellent qualities: the first requisite of a good vine is that it shall produce grapes in contradistinction to an excess of wood, for it will always produce sufficient wood. It is necessary that the graft should be as small, if not smaller, and not more vigorous than the subject to which it is attached, in order that it shall make a good union and not outgrow the capabilities of the root; this is especially true with regard to the grafting of American vines, which are generally smaller than branches of the same age from the *vinifera*, or European vines.

I will not go on here without demanding an attentive examination of the particular bud which is to produce the vine to come. We find it composed of a little protuberance, round, smooth, and pointed, in which exists the embryo of the future growth, protected from

heat, cold, and wet by a downy covering, which is in turn covered by small scales, making the whole close and solid. By the side of this principal bud is found an auxiliary, sometimes called latent bud—often a number of them forming a precious reserve to take the place of the larger one in case of its loss or damage. This little bud is somewhat hidden, and sometimes scarcely visible, but it is long-lived; being less exposed to accident, it often survives the other. Between the time of pruning and that of grafting, in the handling, etc., damage is apt to be done to the most prominent bud, or it may put forth owing to a premature action of the sap; then the smaller bud, as yet uninjured, takes its place. To avoid loss, we must appreciate the value of this modest and obscure organ.

The bud is quite often injured, or perhaps rotted, and when so may be to all appearances intact and perfect, but nevertheless completely destroyed by over-abundant moisture, which rots the embryo within its retreat. One of the buds may be examined by raising the scaly covering, and proceeding with a study similar to that already indicated for the pith, inasmuch as the modifications have more or less the same appearance and produce similar results. Another symptom of alteration is found in the bud becoming soft instead of being firm and hard to the touch, in which case it may be easily raised or dislocated by handling. The cutting is then in poor condition and should be pitilessly rejected.

To be sure the auxiliary bud is present to supply the loss of the other, but we can never determine what may be its condition. Prudence recommends that we should employ only those buds which are perfect in appearance and rely on the auxiliary bud, only to take the place of the principal bud in case of accidents arriving after the grafting.

A more extensive and more complicated problem arises in the choice of the variety than in the choice of the graft—be the grapes for the table or for the winery. Each country has its customs and its preference: the Pineau, the Sauvignon, the Syrac, the Cabernet, the Gamay, the Mondeuse, the Grenache, the Carignan, the Mourvèdre, the Spiran, the Malbeck, the Côt, the Folle, the Aramon, and a few others, continue always the first in those regions established as their empire by the good results obtained from them. It is certain, however, that grafting brings in numerous and valuable additions to the choice of cuttings used in each region. It is a study which is only begun, and merits the attention of viticulturists generally.

The only general rule which can be laid down is to always bring the varieties from the north to the south, rather than from the south to the north. By this means is secured the first and most indispensable quality of the grape, its complete and certain maturity.

It is not necessary to exaggerate this rule by bringing them too great distances; but in order to secure perfect maturity and all the proper qualities, it is necessary that the grape should hang on the vine long enough to ripen and mature slowly. If the Burgundy vineyards, with their peculiar soil, were transplanted to Toulon, I doubt whether its Pineau, which ripens at the beginning of August, would give wine by harvesting at the end of September.

Personal experience and comparisons of experiences are the best guides in this important and interesting question. Reference should be had to the work known as *Le Vignoble*, written by Messieurs Mas and Pulliat, or to "*Descriptions et synonymies de mille variétés de vignes*," by M. Victor Pulliat.

V.—THE ENGLISH GRAFT.

In order to better understand the different methods of preparing the clefts, tongues, and cuts which go to make up the Champin graft, and to understand the differences and advantages it possesses over the English graft, it will be necessary to explain it in theory. In studying the organisms of plants, we find that the parts do not join, by the circulation of the sap between superimposed cross-cut surfaces formed by bringing the parts together end to end; but that they join readily when the parts are brought one against the other, severed in a direction nearly parallel to that of the fibers of the wood.

Fig. 51.

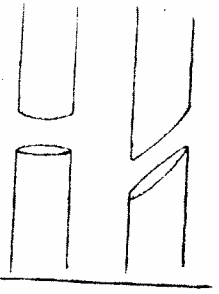


Fig. 47. Fig. 48.

This explains the facility of joining the graft by approach; the difficulty of joining the parts merely separated and superimposed, and the particular necessity of striving in all cases to approach nearest to the parallel cut surfaces of the cells.

39.—SIMPLE ENGLISH GRAFT.

Figures 47, 48, 49, 50 indicate the progression that is necessary to follow to lengthen out the joining parts, end to end, and to approach that parallelism which assures the uniting of the parts. Figures 49 and 50 indicate the cutting practiced for the simple English graft, and Figure 51 the parts united.

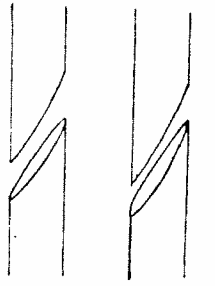


Fig. 49. Fig. 50.

This cut constitutes a progression, at the end of which the parts are sufficiently elongated to make them unite. This system is used for certain varieties of plants subjected to gumosity, such as the apricot; but it is an objection to this system that the surfaces, being oblique, it wants solidity, and, for slight causes, the parts are apt to become dislocated. .

40.—ENGLISH CLEFT GRAFT.

In order to remedy the above inconvenience, there are made one or several little tongues on one to insert into one or several incisions made in the other to receive them, in which case each little tongue adds not only to the solidity of the graft, but also to the chances of the ready circulation of the sap. It augments the number of surfaces brought into contact, which amount to considerable. The tongue and the cut to receive it is one third the length of the oblique cut, which has itself the length of about three times the diameter of the graft.

Fig. 52.

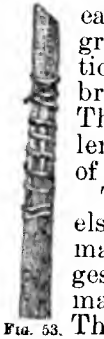


Fig. 53.

These are about the dimensions given in the models and treatises on grafting. All of the designs are made in such a manner (Figs. 52, 53) that they suggest immediately the idea whether the tongue can be made equal in length to the cleft prepared for it. The truth is, that beginners are often arrested with

this difficulty in cutting against the grain of the wood, which, if well done, may answer, but if not fitting, defeats the success of the graft.

In reality, it is impossible in practice to bring the two surfaces into such perfect contact as is shown in cuts and designs.

Figures 54 and 55 give us an idea of just how the English cleft graft looks in practice.

Examining Figure 54, the transformation necessary for the parts to undergo in practice in order to enter one another is truly seen.

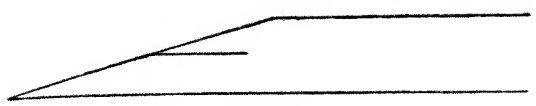


Fig. 54.

Figure 55 represents 54 changed, as becomes necessary. Now, endeavor to make the tongue *F, I, K* enter the slip *B, A, D,* and the tongue *A, D, E* enter the cleft *G, F, I.* This is where the difficulty arises. It is necessary that the angle *A, B, C* be brought against the line *I, K,* and the angle *F, G, H* against the straight line *D, E.*

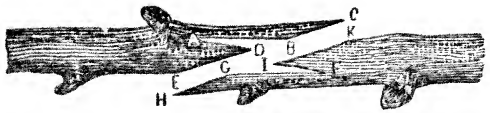


Fig. 55.

In theory this appears impossible, but still it can be done approximately, thanks to the flexibility and ready compliance of the wood of the vine. The tongues enter, bending a little in the corresponding clefts and the salient angles *B* and *G* broaden out somewhat, being applied at the middle of the straight line *I, K* and *D, E;* and when well tied, we obtain something which resembles, in a measure, Figure 53.

In spite of the easy bending and joining surfaces of this graft; in spite of the good results that it gives—thanks to the marvelous facility with which the parts of the vine unite—the imperfections of a defective cut subsist nevertheless, though perhaps hidden in the graft. It further presents grave difficulty in adjusting. The angular surfaces *A, B, C,* and *F, G, H,* always tend to separate from the straight surfaces *I, K,* and *D, E.*

When the two tongues are inserted into the clefts formed to receive them, a difficult task occurs. If the parts be not pushed tightly together the graft will want solidity; on the other hand, if they be pushed too far the tongue will lap over the bark, and there will be no connection of the sap.

The long tongues which terminate each part are, besides, very difficult to make regular by hand as they vibrate under the knife; if using a machine they are apt to crack and split. They have but one apparent advantage, viz.: that of giving good shape to the graft. But this is not what we are after. The appearance at first amounts to but little; it is the complete union which we desire—the connecting of the sap. Therefore I would suppress the long and defective points by cutting them off at the angle; not concerning myself with making an angular surface accommodate itself to a flat surface.

As it has been demonstrated that parallel surfaces unite more regularly than oblique surfaces, I would make the surfaces as parallel as possible.

One of my wise colleagues, who has published a treatise on grafting by means of machines, wrote me some time since that, "the fewer surfaces of contact there are the more chances of union."

From which it follows, as a mathematical consequence, that, to have an unfailing union, it is sufficient to have no surface in contact. It might be construed thus.

I do say myself that, the more surfaces brought into contact the more chances there are of union, and for this reason I have elongated the tongues and clefts of the English graft; adding not only the advantage of greater surface, but also that of parallelism to the fiber.

And I believe I have obtained a quadruple advantage, that of putting into uninterrupted contact equal parallel and numerous surfaces. I have obtained further a greater solidity than that of the English graft.

With these remarks, which are not completely useless, we will now return to our subjects and grafts, which we left in the garret, or other grafting room, arranged in good order, on a clean table.

VI.—CHAMPIN GRAFT.

41.—ON A ROOTED VINE OR NODE DUG UP.

We will first graft a rooted vine or rooted node. With pruning shears, or, better, with pruning knife, cut off the head of the plant as near as possible below the bud and above the part to which the graft is to be made, having first chosen an internode, as long as possible, lying between this bud and the next below. The head thus removed from the rooted vine gives us a plant similar to a rooted node.

Now follows a preliminary operation, which, although not indispensable, is practiced by the careful grafter: it is that of wiping clean the end to be operated upon with the corner of an apron, or, better still, with a coarse cloth kept for this purpose. This work can be quickly done, and is time gained, as we then may readily see the condition of the cut.

With a grafting knife, simple, strong, thin, wide, and not too long, possessing a large handle sufficient to fill the hand well; split the

Fig. 56.

subject about a third or quarter of its diameter from the lower side, running this slit one or two inches long, varying with the size of the plant. (Fig. 57.)

Fig. 57.

It now becomes necessary to grasp within the left palm, which should be above, the thumb well extended, and the index finger closed on the plant in such a way that the roots may be beyond the thumb; the direction of the stalk should then be toward the face, and such that the transverse slit to be made may come above, and that the surface formed thereby may be parallel to the line which passes between the eyes of the operator. (Fig. 58.)

With the knife, seized and held tight by the four fingers of the right hand, which fingers should be so near the blade that it comes part within the hand, so as to serve as a lever against the thumb, the extremity of the knife, approaching the thumb, severs all the wood above the connecting point by a diagonal cut. The width of this cut enlarges in the center of the plant, and terminates when reaching the slit already made.

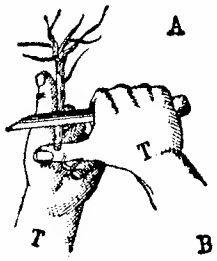


Fig. 58.

This operation is extremely simple, but to facilitate the labor as much as possible it is necessary that the blade of the grafting knife should be dressed off perfectly smooth on the under side, and that this side should never be ground on the stone. The blade should be always sharpened on the upper side.

Fig. 59.

It is seldom that we are able to sever the cane with a single stroke, except it be done by a machine; but it is of little consequence whether it be done by one or several cuts. The principal requisites are that the surface prepared should be smooth, single, regular, and uniform clear up to the point at which it joins the cleft (Fig. 59).

After the subject, comes the graft. It is easy to pick from those before us a scion which approaches nearly in size the subject to which it is to be attached; if the rooted plant be warped or arched we may find a scion to correspond.

If the two be equal in size, it is the better; if the scion be smaller it is of little consequence, but the scion should never be larger than the subject. The graft is usually composed of two eyes, and, like the subject, though in an inverse order, should be cut off below the eye in such a manner as to furnish a long internode. Thus the joining parts may correspond and be made perfectly similar in length and shape.

This done, nothing is easier than to join them; taking one part in each hand, the slit of one to the left and the slit of the other to the right, they may be pushed easily into place and maintained there in such a manner that the bark is joined throughout its whole length, at least on one side. *Now, make sure that the extremity of each tongue touches the bottom of the corresponding cleft* (Fig. 60).

There remains now but to regulate the extremity of the two exterior tongues. They should be cut off, squared, or sharpened down, depending on their fit. They do not want to reach quite to the commencement of the tongue to which they are attached. By this means a notch is left with angle of fifty or sixty degrees on the side now formed.

Some have objected to this system because it leaves this notch exposed; this objection, however, is readily overcome by supplying a covering of wax or mastic. Nature follows the example, and soon supplies a covering of bark, new, more regular and certain than the artificial covering used on the English cleft graft.

It is often asserted that the wound made below the earth surface will not heal as will that exposed to the air; but this is a mistake, for, if properly covered with mastic, it heals better beneath the surface than it could above. The earth serves as an additional seal, which, if added to the one we have added carefully at the time of forming, the wound makes a union hard to find at the end of a year, and seldom distinguishable, except by color of the different stocks.

Fig. 60.

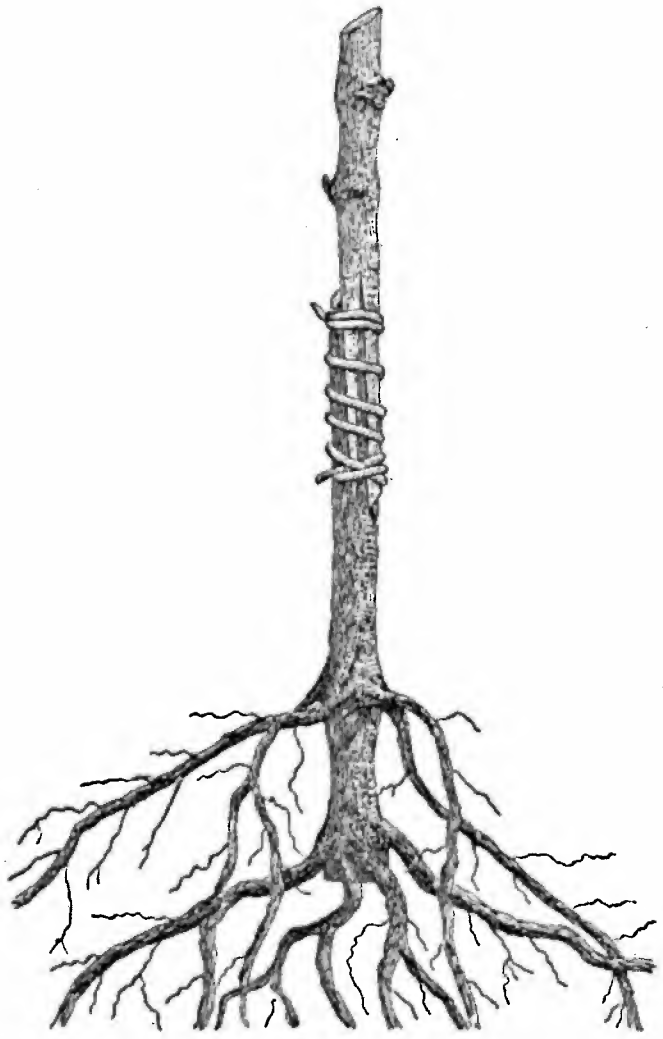


FIG. 61.

42.—GRAFT OF THE CUTTING.

In grafting the cutting, the tongue, cleft, and all are formed the same, with a single exception, very important to observe. The graft on a cutting is usually less certain than that on a rooted plant. I say "usually," because in the year of 1879 my experience and that of most other viticulturists was otherwise; therefore, instead of leaving and utilizing a long joint or internode at the top of the cutting to graft with, it should be short, something less than two inches; anything, so that we may graft above the upper bud, *O* (Fig. 62). Now, if the graft does not take, we may still have success with the rooting of the cutting. This will be better understood when we come to speak of the planting.

If by any accident in the handling of the cutting, it be deprived of its buds, though it be planted and form roots—which it may do without any buds—it may yet be made whole and utilized by grafting in, and thus supplying the necessary and missing part; otherwise it might be wholly lost.

It is seen that we may add buds to the rooted plant, and it is further seen that roots may be grafted upon an unrooted plant. Right here the question arises, "Is there any advantage in a grafted cutting over one not grafted, as concerns its rooting?" I say yes; for, in theory, the sap of the cutting when planted is drawn upon for the formation of branches at the expense of the root. Now, by interposing a joint which will momentarily retard the ascending sap, we are favoring the root. From practice I am able to cite a case in point, viz.: in 1879 the percentage of rooted vines obtained was greater from my grafted cuttings than from my simple cuttings.

FIG. 62.

43.—GRAFTING THE ROOT.

The saddle graft (*à cheval*), which has already been given, I consider simpler, easier, and more readily executed than mine for uniting a cutting to a root; but it lacks solidity, and is not so sure to take as a double cleft. If, then, we desire to hasten and facilitate the work and make it sure, as well we may, unite the two systems—the saddle graft and the Champin, which is easily done, as represented in Figure 63.

If the cutting which we desire to graft possesses a spur, a cross or butt piece, or any enlargement whatever, it is all the better for the saddle graft, as the protuberances favor the emission of roots. We allow to remain intact the side having the enlargement *T* (Fig. 63), and make the sharp tongue destined to be inserted. After adjusting it we obtain a graft, which, on one side, is

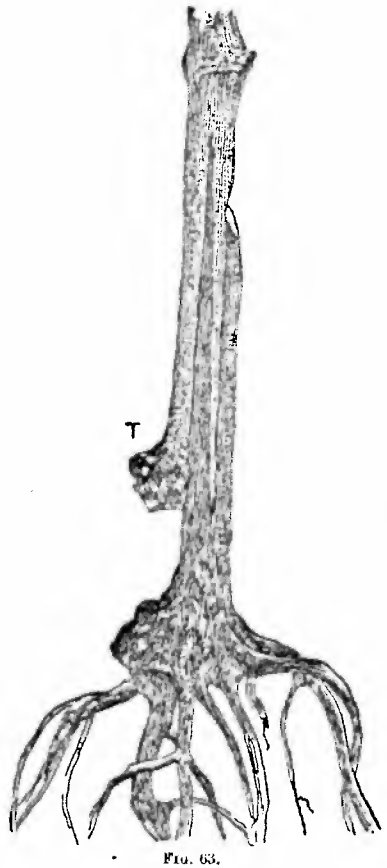


FIG. 63.

the Champin graft, and on the other side a saddle graft.

I consider the root graft and the saddle graft as valuable means of making rooted cuttings; but if desiring to employ the roots as regular grafting stocks for French vines, it becomes necessary to graft them simply as rooted nodes or cuttings.

44.—SIMPLE AND DOUBLE LAYER GRAFTING.

In this case the work within doors is interrupted, and, unable to bring the mountain to us, we must now go to the mountain; or, in other words, we must seek the vine in the field or out of doors. The Champin graft is equally applicable in the open air, either to unite the cutting or scion to the old trunk; or the resistant cutting may be affixed to a cane, and to this the desired variety, grafted as indicated in numbers 28 and 29, Figure 38, *F*, and Figure 39, *F*, using, however, the Champin graft.

45.—GRAFTING THE VINE IN PLACE.

Grafting the vine in place is favorable to the use of many kinds of grafting, but particularly to the Champin graft, because it possesses double the chance of taking on small plants, and these are the ones usually operated upon, especially if grafting resistant vines. To be sure, the vine split to receive the scion may be so irregular as to require the latter to be sharpened in a knife-blade fashion, in order that it may be adjusted to the irregularities; but this offers the double assurance of its taking.

If we desire to root the graft, to enable it to free itself from the subject grafted, the Champin saddle graft should be used: but if grafting a non-resistant upon a resistant variety, near the surface; to avoid its taking root, it should be grafted with the double cleft and tongue, in order that it shall not only be a good graft to take, but also to make it secure against damage from the winds.

46.—ABOVE GROUND WOODY AND HERBACEOUS GRAFTING.

I have attempted to graft the branches of an old vine, resistant

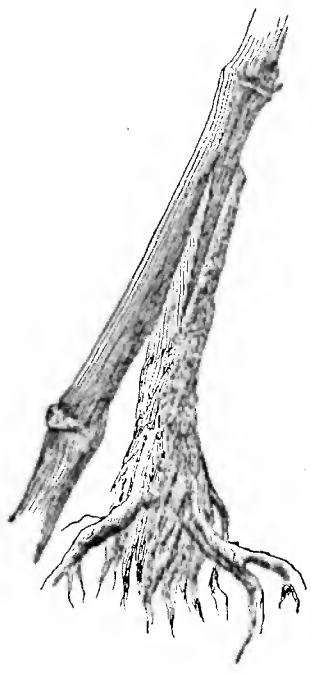


FIG. 64.

scions, on non-resistant branches and *vice versa;* further, I have had them take, but in such small proportion that the success of the method remains a question involving principally the value of the grafting wax used. This method should be employed seldom, being of value only for experiment.

47.—LATERAL DOUBLE CLEFT GRAFT OF CUTTING ON ROOT.

This is an ingenious application of my system, for making more certain the taking or rooting of the cutting of resistant stock which may be grafted by this method (Fig. 64), either within doors or on the roots of young plant in place. It assures a vigorous growth of the resistant plant thus formed. If employed in grafting a non-resistant variety on a resistant, it possesses the advantage of allowing no roots to form on the graft above the point of union.

It may also be advantageously employed for grafting one resistant stock on another where the second has already been growing in vineyard, and where it is desired to change the variety.

48.—LATERAL DOUBLE CLEFT GRAFTING ABOVE GROUND.

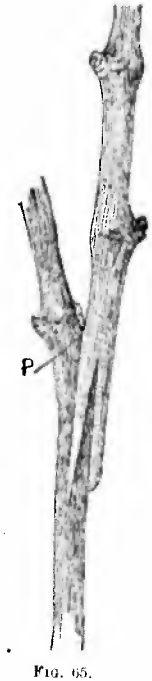


FIG. 65.

The advocates of my system compel me to give or explain its application to this purpose, so easily understood. (Fig. 65.)

I fail to see the application of this complicated lateral system to grafting non-resistant on resistant vines.

It is only reversing the saddle spur or *talon* graft, with the difference that the spur in that case is designed to produce roots, and in this case it utilizes a bud to form a branch, which branch, robbing the graft thus formed of an amount of sap, is eventually cut off at *P* (Fig. 65) and lost. The sap might otherwise go to nourish the graft.

It appears to me that this graft would be of use only in two cases: first, if one desire, as a matter of curiosity or interest, to make one plant bear a number of varieties of grapes and to obtain this result by above-ground grafting, which, by this double cleft is more assured of taking; second, when desirous of covering a trellis, as is done with pear or other trees, by bringing the canes together; this, however, can be better done by employing the

49.—ARCH GRAFT FOR REPLACEMENT,

Which consists in drawing a neighboring cane to the point of desired union, *I* (Fig. 66), and of grafting it at this place, perhaps by the end, as in Figure 48, if wished; may be by approach with simple incision (Fig. 11)

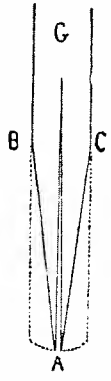
may be by approach by round incision (Fig. 36); may be by simple plain approach, or, it may well be, by

50.—GRAFTING BY SIMPLE INCISION.

This graft has been referred to twice previously—once for affixing roots to cuttings, *B* (Fig. 41), and again for one cane on another.

Fig. 66.

The Versadi graft, *G* (Fig. 42), of which I give an example, *I* (Fig. 66), will not need other explanation, its simplicity rendering it readily understood.



Now, if I were to enumerate and explain all of the combinations and modifications which occur in grafting by the preceding system, I could never hope to finish. When the grafter has before him the parts to be united he can always find new combinations, which are in a measure suggested and even demanded by the work in hand; others, too, will be suggested by the desire to invent and vary the ordinary systems.

I will finish this long and, of necessity, incomplete list of methods of grafting vines, by one, which, if it were not so long and complicated, would be the best of all.

51.—TRIPLE-CLEFT GRAFT.

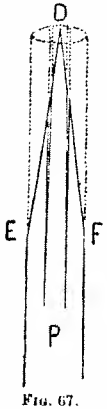


Fig. 67.

This method was suggested to me in 1878, at Carpentras, by an old grafter, whose name I have forgotten. He explained it to me, saying: "To the graft made I will add another tongue and cleft, which will augment the uniting surface and the solidity of the whole. I have employed and succeeded with this graft for terminal herbaceous grafting on resinous vines, which I have been unable to unite by any other method." He then proceeded with a sharp thin blade to split a tongue and then doubly split another, which, being joined, made a good union.

I myself have tried this perfected graft, but do not think it applicable for general use on a large scale. A recent letter from my distinguished friend M. Eugène Raspail, asserts that this method is perfectly successful with M. Rayband at L'Ange; and further adds, that a good grafter can do this as rapidly as he can employing the Champin graft. This last assertion I have reason to doubt, but my personal experience with it has induced me, after trying a great many other grafts, to recommend and to explain it as follows:

Split the graft *G* (Fig. 67) for a length of four or five times its diameter; then proceed to pare down the two sides, following the lines *B A* and *C A* to a point.

Fig. 68.

Make two clefts or splits in the part graft *P*, such that they divide it into three parts of equal thickness, and in such a manner as to injure the pith as little as possible; then whittle down the two sides, following the lines *E D* and *F D* in such a manner as to bring the middle part to a point at its middle, *D*.

Introduce, then, the three tongues into the three corresponding clefts and push them forcibly together, and the operation is done. If it were not for the need of tying in the projecting outside tongues, it would be sufficiently solid without any binding with a ligature.

It is only necessary to examine Figure 68 to see and appreciate the advantages of this graft. There are eight surfaces of contact, and these are as near parallel as possible. In fact, I believe there is no one who has followed me in this work who could not, appreciating the value of these elements in any system, guarantee the taking of a graft by the above procedure.

There are, of necessity, by this system, two naked spots or exposed places made, as with the Champin graft. But these surfaces, known to exist, though the terror of the grafter by the English system, are easily covered by a little clay, the bark following soon after. A long experience has taught me that the more these exterior tongues are suppressed the more the vine is disembarrassed of useless and often injurious appendages.

But the principal advantage of this system has not yet been given, viz.: it diminishes greatly the chances of the scion rooting, and thereby freeing itself of the resistant stock. It is so clearly and completely surrounded and clasped by the lower part as to be scarcely able to put forth any roots.

If this method may ever be so rapidly done as to make it practicable on a large scale, as, for instance, by machine, such as has been invented for this graft by Mr. Leydier, it will render great service to viticulture, and be superior to all other methods, the Champin graft included, because it is the Champin graft perfected.

VII.—LIGATURES USED IN GRAFTING.

We have now passed through a number of the operations which belong to grafting; there remain still others, each of which I would recommend, as those we have passed, as important. I never fail to explain to each workman, whether he has to prepare the grafts or to split the plants to receive them, or whether he adjusts them, ties, waxes, or plants the grafted vine, the great importance of each particular operation. To prove that all parts of the work are equally important, we need only observe that if one be poorly done it compromises the whole work.

The ligature used in fastening the graft should be fine and strong. Some employ yarn, some wire, or may be rubber string, sometimes plain and sometimes prepared; rushes, bark fiber, sea-grass, matweed, linden, mulberry, willow or palm fiber, commonly termed "raphia," each of which has its advocates, from which I conclude that it possesses advantages.

I have always had poor success in the use of woolen yarn when grafting the vine in place. It is not tight enough at the time of grafting and becomes too tight afterwards.

With fine wire, which binds the graft perfectly at the time of operating, there is risk of strangling the plant soon after, for it is so small as to cut readily into the growing plant, and is not apt to yield. Being so fine, it soon becomes enveloped in the bark, and is therefore difficult to find or remove.

Rubber is often employed, and, by those who use it, highly spoken of. Not having used it, I am unable to say anything against it; but I doubt very much its value. Among other objections, it has a terrible enemy in the ant.

A small string does very well, though unnecessary trouble is sometimes incurred to make it more lasting. I believe it lasts long enough without any preparation.

Sea plants, grasses, etc., furnish a number of ligatures with which the southern grafters are very well satisfied. The bark fiber of trees and plants, such as the beach and the linden, when in threads, is used; that of the mulberry and the willow appears to be quite insufficient, inconvenient, and only serviceable for want of better.

As for me, I employ only raphia,—a species of herbaceous palm, which grows—I don't know where. The leaves, which are from three to six feet long, and from four to six inches wide, are of a pale yellow silky color, supple, soft to the touch, and of a strength which surpasses, when it is rolled and twisted, that of any of the other ligatures which I have mentioned.

Raphia has another advantage: it lasts indefinitely in the air, but in the ground it rots and disappears so quickly as to run no risk of strangling the wood, thereby is avoided the annoying and difficult operation of detaching it from the plant. This advantage in raphia becomes, under certain circumstances, an inconvenience. In the Spring of 1879, when all the atmospheric agencies concurred to render grafting unsuccessful, the raphia itself played its part among the damaging elements; and in place of lasting for a long time, and thus compensating for the retarding temperatures of the season, it rotted

quickly, and had to be temporarily condemned for having this time disappeared before it had completed its useful mission of allowing the parts to unite.

To remedy this difficulty the raphia should be plunged in a solution of sulphate of copper for a certain time, and thus made to endure long enough. In varying the quantity of sulphate of copper and the length of time immersed, there may be obtained for raphia a sort of chromatic scale of its resistance to rot in moist earth; then one may employ short, long, or medium time, according to the service for which it is designed.

Whatever may be the ligature used, it is necessary that it should be tied very tight—in fact, as tight as possible, and the turns, aside from the first and last two, should be left sufficiently apart to facilitate the waxing.

In commencing, the fastening should be tied by passing over itself, like a half hitch, and should be ended by a dexterous move of the finger in passing under itself once, or better twice, in order to make it a charvietier knot. (*N*, Figs. 13, 24, 60.)

The women, novices, and little boys are employed for the tying, it being one of the precious auxiliaries, but it is necessary to charge them often to tie it strong. To continue pulling and tying the strings to make them tight, throughout the day, is more fatiguing than one would expect. Others do not always have the chance that I have had in employing an old and experienced tyer, and should, therefore, never for an instant forget the necessity of having the new joint solid. On this I insist as much to my readers as to my workmen.

Between grafting and gathering the grapes the plants must pass through many trials; many obstacles there are to overcome, many dangers and enemies to avoid and vanquish. The most dangerous of all enemies in extensive cultivation, and that which it becomes most often necessary to punish, is the workman. If each good grafter could give to the grafted plant all of the care, labor, and operations necessary to complete the work, one might then rest assured of its being properly done. It would generate an affection like that for his children, whom, owing to the total responsibility resting upon him, he cares for in such a manner as to eliminate all danger. This can only be the case, the good workman doing all, with small plantings, and it is this which explains the marvelous successes obtained with small numbers, though the means be limited.

In proportion to the acres to be grafted, must the work be divided. Some must work at grafting, some at tying, some at waxing; some must carry the plants and arrange them; others must take them to the vineyard, others plant; others still must fill up the holes, keeping all busy with both hands and feet, and that by experts in their several departments, such that no necessary move, cut, tie, or motion may be neglected which would add to the solidity of the plant—for the vine in place, the work is never done. After having performed the above named operations carefully, to finish off, a new enemy appears, not less terrible and inevitable than the others, viz.: the wind.

To combat this it is only necessary that it be as tightly and as solidly put together as if it were only one piece. When my system is used, this is guaranteed in being conveniently adjusted, tied, and by nature attached (Fig. 63.) It is then as difficult to break, wrench, or

separate it as if it were all in one. From grafting to planting, innumerable causes there are to injure the work, which, if successfully avoided, become only a matter of gratification, and, once nature makes its union, there is no more danger of its breaking at that point than at any other.

VIII.—MASTIC USED IN GRAFTING.

At the risk of contradicting numerous theories, and without desiring, under any consideration, to dilate on the numerous manufactured articles used in grafting, I will assert that there is no wax or mastic at present known equal to clay.

I have already said that aerial grafting, when the sap is dormant, is possible with the vine, but very uncertain when applied on a large scale; the difficulty to which failures are mostly attributable is in the finding of a proper wax or mastic to be used. A wax specially adapted to the above-ground grafting of the vine has not yet been found.

The comparative studies and numerous experiments that I have made are too long to recount here; my conviction that certain resinous emanations prevent the consolidating of the parts would doubtless give rise to useless contradiction. All who have made a fair trial will agree with me that the only reliable and best mastic is clay.

I would, however, invite all viticulturists and manufacturers of mastics to engage with me in the solution of this problem: the finding of an ointment which will assure the uniting of the parts of an aerial graft. It would render an immense service to viticulture, and if I ever find the desired mastic my grafting confreres would soon become acquainted with the new discovery.

While waiting for the above we will be obliged to confine ourselves to grafting beneath the surface and the use of clay as a mastic.

Clay is fine, soft, unctuous, and, best of all, it is found at home. It is convenient to obtain at the time of grafting, though difficult to handle if too dry, and more so when too wet.

To augment the tenacity of clay we may follow the directions of Saint Fiacre, and add a little soft, green, and fresh vegetable matter, preferably cow manure, which may be picked up along the road.

A little salt and water, employed to give the mixture a proper consistency, will preserve it fresh and moist, by making it absorb moisture from the surrounding atmosphere.

This mastic is not dear, and it is not necessary to spare it, but it may be put on in sufficient quantity to last. In order that it should hold, it is best to put on two layers, perhaps using the fingers, perhaps a little wooden spatula, which is very serviceable if intelligently used.

The first time applying, little should be used; but it is necessary that it should enter every part and be pressed hard to make it connect and adhere throughout. If we put on too thick a layer at first, there is considerable risk of its not entirely surrounding the wood, thus allowing the entrance of the air, which would tend to dry and crack off a part of the mastic before planting. The second layer, if properly applied, removes all possibility of the air entering, the clay adhering easily to clay; the whole may thus be made half an inch thick.

The last precaution, which few grafters take, but which is a valuable one, is that of waxing the upper extremity of the graft.

When grafting on a stock, the buds of which are close together, thereby forming short internodes; it is best to have the upper cut of the graft as far as possible above the last bud of the graft. If cut close

to the bud from which we expect the vine to develop, the bud is very apt to dry out; I would recommend covering the scion, when grafted, with earth or sand. In any case, the upper bud is best preserved by applying some sealing material or mastic on the terminal point of the scion; said mastic should not be soft, and yet not subject to crack off or dry up. The ordinary grafting wax, as used on trees, would be suitable for this purpose.